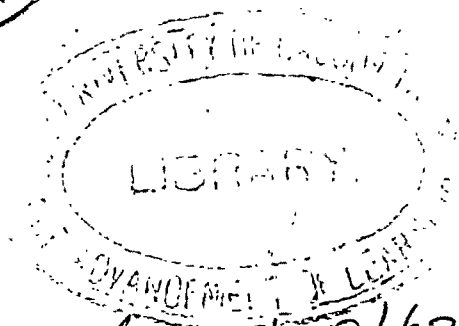


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VOL. I.

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A JOURNAL OF NEUROLOGY.

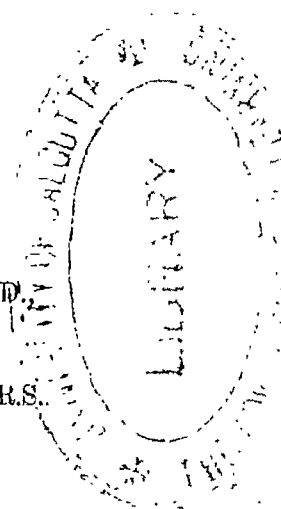
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J. CRICHTON-BROWNE, M.D., LL.D.

D. FERRIER, M.D., F.R.S., AND

J. HUGHLINGS-JACKSON, M.D., F.R.S.



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BRAIN.

APRIL, 1878.

Original Articles.

NOTES ON THE SYMPTOM-SIGNIFICANCE OF DIFFERENT STATES OF THE PUPIL.

BY JONATHAN HUTCHINSON, F.R.C.S.,

*Senior Surgeon to the London Hospital, and Surgeon to the Royal London
Ophthalmic Hospital.*

THE usefulness of the Iris, in its various conditions, has long been acknowledged in reference to the investigation of diseases of the nervous system. It has not, however, I think, received as yet that detailed examination which it deserves, and which is necessary, if in the first place we would avoid making wrong inferences; and in the second, if we would avail ourselves of all the help that can be easily got from it. We must not be content to record "pupils contracted," "sluggish," "motionless," "unequal," &c., as the case may be, without pushing on our enquiries as to the pathological cause in each instance of the sluggishness, smallness, or immobility. These several conditions may in turn be due to very various pathological states, and their symptom-significance may be very different in different cases. It is in the hope of helping a little to the clearing-up of this subject that I have written out the following notes. I must own that I feel considerable diffidence in offering them to the readers of *BRAIN*, since they proceed from the pen of one who is familiar rather with the practical

aspects of ophthalmic medicine than with either modern cerebral pathology or experimental research. On both the latter subjects I must ask indulgence for any ignorance I may display.

In examining the pupil, we concern ourselves chiefly with (1) its shape; (2) its size; (3) its activity; and (4) with any differences in any of these respects which may be observed between the two eyes. In order that errors may be avoided, it is essential that the investigator should employ efficient methods of observation, and also that he should be well aware of all fallacies. As regards the latter, he must understand as definitely as may be how far deviations from what is usual may still be within the range of what is compatible with normal function. I will say a few words on each of the four points.

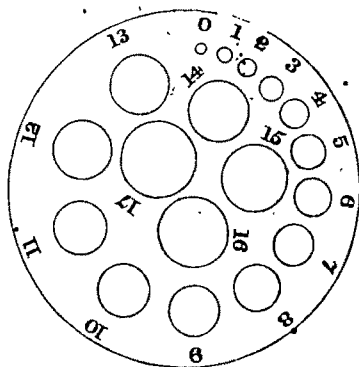
I. *The Shape of the Pupil.*—In the human subject the pupil is, as a rule, round; but slight deviation towards an oval form may not unfrequently be observed under conditions which lead us to regard them as probably personal peculiarities. In glaucoma and some other diseases of the eyeball, the pupil may become definitely oval. We know, however, as yet, too little about the causes of these deviations from the circular form, as the result of disease, to be able to make much use of them as symptoms. On the other hand, the irregularities which result from adhesions to the lens capsule, and which are so common, are often of the utmost use in helping us to the diagnosis of syphilis on the one hand, or of the arthritic diathesis on the other. I may, perhaps, be here excused for hinting that it is quite possible in cases of old iritis, where the lustre of the iris has been perfectly restored, to overlook the presence of adhesions, and to ascribe the small size and immobility of a pupil, which are due simply to mechanical fixity, to a neurotic cause. This is especially the case when the adhesions are extensive, the pupil round, and the iris of a dark tint. The use of magnifying power is strongly to be urged in all cases in which the pupils differ in size; and if this be not sufficient to clear up all doubt, oblique illumination must be employed, or atropia resorted to.

When synechiæ are found, they are usually attended by

pigment deposits on the capsule also, and it often becomes of great importance to decide as to the character of the iritis which has produced them. Very frequently we have in this question a clue to the diathesis of the patient, and in many cases, especially where syphilitic disease of the nervous system is suspected, the discovery that there has been former iritis may be of the greatest value in support of an imperfect history. It would be out of place here to speak in any detail as to the retrospective value of iritic adhesions; but I may, perhaps, be permitted, on account of the great importance of the matter, to interpolate a few words. If iritic adhesions are found without other changes, and with the history of a single attack of inflammation of the eye in early adult life, they should be allowed very considerable weight as implying a suspicion of syphilis: Under such circumstances, careful enquiry should be made as to other corroborative facts. It is, however, a very dangerous error to assume that almost all iritis is syphilitic, and that therefore adhesions almost always imply that disease. My impression is that arthritic iritis is at least as common as the syphilitic form, and when it occurs it invariably leaves adhesions. The two may, however, usually be distinguished from each other by the history; for the arthritic form always tends to relapse, and often there is the history of an annual or bi-annual attack during many years. Relapses, on the contrary, are rare in the syphilitic form.

II. *The Size of the Pupil.*—Having often felt the need of some easy means of measuring the pupil, and of expressing its size in note-taking, with more accuracy than the adjectives in common use attain, I have been in the habit of late of employing as a pupilometer the perforated plate used to measure bougies. The accompanying woodcut will explain it, better than any description can, to those who are not already familiar with it. The plate is made of metal, and the holes are numbered 1 to 14. In use I place the plate on the patient's cheek, just below the eye, and turn it until the hole which corresponds in size with the pupil is found. The number of the hole is then noted. The measure is of course only approximative, but having often asked several observers to independently estimate pupils by this means, I have usually found that there was a

very close agreement. It is much simpler and easier of use than the pupilometers hitherto proposed, and its results are, I think, as accurate as can be expected. It may be easily



extemporized by marking out a number of circles on a piece of card.¹ The adult pupil in good daylight averages probably about No. 4, but considerable deviations on each side of this must be expected. The pupils of children and young persons are usually larger than those of adults, and in senile periods still further diminution takes place. Myopic eyes which do not require accommodation usually have larger pupils than others. But independently either of age or sex, or of state of refraction, considerable differences in size must be allowed for as being simply personal peculiarities. Speaking generally, it may, I think, be asserted that there is a relationship between the size of the pupils and the state of the patient's nerve-tone, due allowance being made for age and the other circumstances just mentioned. If the tone be low, the pupils are large. The size of the pupils is almost in inverse ratio with that of the arteries. With relaxed, feeble, and irritable arteries we have usually large pupils; on the other hand, when the arteries are in a state of spasm, as in rigor, the pupils dilate to their

¹ No. 0 measures about one-third of a line; No. 1, two-thirds of a line; No. 2, a line; No. 3, a line and a quarter; No. 4, a line and a half; No. 5, a line and two-thirds; No. 6, nearly two lines; No. 7, two lines full; No. 8, two lines and a quarter; No. 9, two lines and two-thirds; No. 10, three lines nearly; No. 11, three lines full; No. 12, three lines and a quarter; No. 13, three lines and one-third; No. 14, three and one-third; No. 15, three and two-thirds; No. 16, four lines; No. 17, four and a half.

maximum. These facts are not, as they may at first mention seem, contradictory. In rigor the vaso-motor nerve throws into spasm most of the muscular structures which it supplies, and thus the coats of the arteries and the dilating fibres of the pupil are made to contract. The dilatation of the pupil which goes with a feeble state of circulation is due not to spasm of iris, but to defective tone of the retina and nerve centres, rendering necessary a large supply of light. It may also be due in part to impaired tone in the circular fibres of the iris. No condition of defective tone is more certainly revealed by large pupils than that which results from sexual irregularities in early life.

To come next to more special morbid conditions as influencing the size of the pupil, we may remark that the opinion of our forefathers that the "amaurotic expression" had for one of its chief features a dilated and fixed pupil, is certainly a mistake. It is only in a small minority of the cases of nerve-blindness which count as "amaurosis" that the pupil dilates. A patient may be quite blind with white atrophy of the optic discs, and his pupils may yet be rather smaller than natural. Indeed, in but few amaurosis cases do the pupils remain permanently dilated. In cases of acute optic neuritis with almost entire loss of sight, the pupils almost always dilate widely, and remain for some time at least very large and quite motionless. Indeed, I think it is true that in almost all cases in which blindness is rapidly produced the pupils dilate; whilst, on the other hand, when it comes on gradually, dilatation is seldom seen. In tobacco amaurosis, however far advanced, the pupils, although often very sluggish, are rarely dilated. It is certain that more than mere absence of the incident-excitor influence of sight is needed to produce dilatation of pupils, and it may be admitted that there is much in connection with this subject of which it is difficult to offer a satisfactory explanation.

III. *The Activity of the Pupil.*—In estimating activity, in all cases involving any difficulty it is desirable to take much more pains than is usually done. If the pupil obviously acts well, of course there is no need for further trouble; but if there be doubt, great care should be exercised. The patient should be seated in a full light, and each eye should be examined

separately, the other being carefully covered. The observer will find great advantage in wearing for the moment spectacles of + 10, and approaching his face well within their focus, and thus obtaining, without encumbering his hands with a lens, considerable magnifying power. If the iris be dark, it is especially difficult to be sure as to slight movements. Each eye must be tested separately as to the effect of light, the effect of the accommodative effort, and the influence of exposure of the other eye; and lastly, the two should be tested together in strong convergence.

The activity of the pupils, speaking generally, diminishes with age, and is greatest in the young and vigorous. It is quite possible, however, that it may at times betray a morbid amount of sensitiveness on the part of the nervous system generally. A pupil which dilates and contracts very frequently and very quickly, is seldom met with in the best-balanced state of nerve-tone, and usually implies debility. Such pupils usually remain when at their smallest larger than natural. We must make at all ages considerable allowance on this point for personal peculiarities, particularly as regards rapidity as distinct from extent of range. Unusually rapid changes probably occur to those whose mental processes, emotions, &c., are also rapid, whilst great width of range, with moderate slowness in its attainment, may perhaps be trusted as an indication of general vigour.

Before testing the activity of the pupil, the state of the retina should always be ascertained. I have already remarked that a dilated pupil is by no means usually met with in "amaurosis," and I may here add that by no means is it invariable, in states of very great diminution of sight from retinal or nerve causes, for the pupil to lose its activity. I have repeatedly seen the pupils act really well to light where the vision was reduced, in both eyes; to little more than ability to count fingers. This part of our subject deserves from the ophthalmic surgeon more detailed investigation. My own observation would lead me to doubt whether in almost any case, however great the degree of blindness, provided the irido-motor nerves remain intact, the pupil becomes motionless. Much in this matter appears to depend upon the suddenness

of the onset. If sight be very rapidly extinguished in an eye previously sound, the activity of the pupil fails greatly; but if the defect come on slowly, it is possible that the fifth nerve may take upon itself the duties of incident excitor. Activity of the pupil then implies for certain a normal state of irido-motor nerves, but it does not imply by any means soundness of the sensory part of the apparatus. We can also investigate the state of the optic nerve and the retina by far surer and more direct methods, and our examination as to activity of the iris will in almost all cases concern rather the state of the third and vaso-motor than that of the optic itself. It remains, however, of much clinical importance, in cases where both are suspected to be diseased, to be able to assign to each its due share.

Sluggishness of pupils may, in a majority of cases, be held to indicate defect in the vaso-motor nerve, and in these cases usually the pupil is either of normal size or rather smaller than natural. In the comparatively rare cases in which sluggishness is found with mydriasis, the third nerve is of course to be suspected, and the state of accommodation must be examined. The presence of ptosis or of defect of some of the third-nerve recti will however, in most of these cases, have already directed attention to the nerve involved. Senile sluggishness is almost always attended by a degree of myosis, and is indicative of failure of the vaso-motor. It is possible that its degree may be used as an indication of the state of the vaso-motor throughout the body.

When a pupil which is itself sluggish on direct exposure responds immediately when the other eye is exposed, we may infer—1st, that the irido-motor apparatus is sound; 2nd, that the percipient structures in the second eye are sound; and, 3rd, that there is some defect in the percipient structures in the first eye. On the other hand, there are cases in which an eye which can see perfectly and enjoys good use of accommodation, yet has a pupil which does not act in the least on alternate shading and exposure of its fellow. In these cases the demonstration is clear that there is some interference with the integrity of the motor nerves. The absence of cycloplegia leads again to the suggestion of disease in the vaso-motor. If,

in addition to this absence of iridal susceptibility to influence from the other eye, we have also failure of accommodation, then the triad of symptoms is complete, and we must suspect the lenticular ganglion itself.

IV. *As to Differences between the two Pupils.*—I shall have to say so much on these in other parts of my paper that I will not here do more than just hint that it is necessary to guard against erroneous inferences by remembering that precise symmetry of pupils as to size is exceptional rather than the rule.

It is desirable as a preliminary to explain and define certain terms, some of which are already in general use, whilst others, which are more or less novel, seem much wanted.

By the old term MYDRIASIS we denote a state of great dilatation of the pupil. For practical purposes we recognise three forms: the *artificial*, which is produced by the use of drugs; the *paralytic*, which follows usually defect in the third nerve; and the *spasmodic*, which is due to spasm of the radiating fibres of the iris.

The term MYOSIS is the opposite of Mydriasis, and is applied to any condition of unusual smallness of the pupil. We have the same three forms that have just been mentioned in the case of Mydriasis.

IRIDOPLEGIA is a term applicable wherever both circular and radiating fibres of the iris are paralysed, and the pupil fails wholly to respond to the stimulus of light. The power of acting under the excitement of drugs is not usually lost; indeed, this power as a rule fails only when the muscular substance of the iris is itself disorganised. In Iridoplegia we have united the conditions which, when present singly, constitute respectively paralytic myosis and paralytic mydriasis.

CYCLOPLEGIA is a condition so closely connected with the iris that, although it is not, strictly speaking, a condition of the pupil, it will be convenient here to mention it. It is due to paralytic failure of the ciliary muscle, and is attended by absolute loss of the function of accommodation.

OPHTHALMOPLEGIA INTERNA is a term which I have recently

proposed to denote the condition in which both circular and radiating fibres of the iris and also the ciliary muscle are all simultaneously paralysed. Here we have entire cessation of muscular action within the eye. It is necessary to use the adjective *interna* because there is an important group of cases of simultaneous paralysis of all the external ocular muscles for which the name *ophthalmoplegia externa* is wanted.

Although I have mentioned spasm of the various muscular structures as a condition which may produce converse states to those of paralysis, yet, as a matter of fact, we know but little of it in connection with disease. In the laboratory, states of spasm may easily be produced, and the pupil may be made to contract or dilate at pleasure; and hence we may assume that it is probable that spasm sometimes complicates the conditions we witness in disease. But it is, probably, only a temporary state, and the proof of its presence is usually difficult to find. We are familiar in practice with troublesome conditions, in which the ciliary muscle is easily thrown into spasm, but as regards spasmodic mydriasis and myosis, we know but very little. When the dilatation or contraction of the pupil is extreme in degree, we may suspect that spasmodic contraction of the muscle concerned exists, for we know that paralysis of either sphincter or dilator rarely produces extremes of either condition. But in all these examples of extreme conditions, it is probable that paralysis is present, and is the chief agent in the production of the symptoms. There is, perhaps, no reason to believe that states of permanent contraction or dilatation of the pupil ever depend upon spasm alone. We have, in the state of the pupil during rigor, and during the epileptic paroxysm, in some cases, good examples of spasmodic mydriasis. Dr. Hughlings-Jackson has recorded examples of dilatation of the pupil during epilepsy, with smallness of the retinal arteries. I have myself repeatedly examined the pupil during severe rigors, and have found it dilated to an extreme degree, coincidently with almost entire absence of the pulse, a cold skin, and pale, death-like countenance. Here we clearly have a state of spasm of the arteries, and with it we should, of course, expect spasm of the radiating fibres of the iris, since they also are supplied by the vaso-motor nerve. I am not familiar with any example of the converse condition

of spasmodic myosis, but in some of the cases of pinhole pupil in brain disease, it may plausibly be suspected that spasm of the circular fibres is present, especially since we know that complete paralysis of the vaso-motor nerve, whilst it entirely prevents dilatation, by no means produces extreme contraction.¹

The muscular nerve-supply to the iris is, as is well known, from the vaso-motor and the third. The short root of the ciliary ganglion comes from the branch of the third supplying the inferior oblique, whilst from the carotid plexus proceed vaso-motor filaments, which, after passing through the same ganglion, are distributed to the interior of the eye, and mainly to the radiating fibres of the iris. It is probable, however, that the radiating fibres of the iris receive a part of their nerve supply independently of the ciliary ganglion. Hensen and Völcker found that, after section of the roots of the ganglion in the dog, stimulation of the sympathetic in the neck still caused dilatation of the pupil. In Foster's *Text-book of Physiology*, where these experiments are referred to, it is almost implied that the long ciliary nerves, and not those from the ganglion, are those which carry the vaso-motor filaments to the iris. It is probable, however, that both sets share in this duty, and very possible that considerable differences exist in different individuals. The ciliary muscle is mainly supplied by the third. If, therefore, disease existed in the short root before it entered the ganglion, or in the branch from which this root is given off, we should expect paralysis of the circular fibres of the iris and of the ciliary muscle. As a matter of fact, in cases of total paralysis of the third nerve, including of course this root, these conditions are present. The pupil is always considerably larger than natural, and shows no power of contraction on

¹ Spasmodic Mydriasis is induced with unvarying certainty by electric irritation of the corpora quadrigemina, more especially of the nates. First, the pupil of the opposite side dilates, but very soon that of the same side also. The eyes at the same time are widely opened, and the eyebrows elevated. The eyeballs are directed upwards to the opposite side. If the left tubercle is irritated, both eyes are directed to the right. Knoll* has shown (1869) that this dilatation of the pupils from irritation^b of the corpora quadrigemina does not follow, if the trunk of the cervical sympathetic has been divided.

* Eckhard's *Beiträge*, 1869.

^b See Ferrier, page 78.

exposure to light, but it is by no means always extremely dilated. The loss of accommodation is usually almost complete. Disease in the short root itself, and limited to it, is of course rare, but I have diagnosed it in one or two instances by the symptoms of paralytic mydriasis and cycloplegia, without anything else. It is quite possible also that these two symptoms, which are usually combined, may be separated, and that the mydriasis may exist without the cycloplegia, or the cycloplegia without the mydriasis. Such cases are, however, rare, and they are probably to be interpreted by the suggestion of central disease; for it is not likely that disease in any part of the third nerve, or in its branch, the short root of the ciliary ganglion, could destroy entirely one set of fibres, and not implicate another travelling in the same bundle. The state of eye so often met with after diphtheria, affords us the best instance I know of cycloplegia without mydriasis. It is known to be attended by paralysis of the velum palati, and sometimes by pharyngeal or even by limb paralysis also. Its precise pathology is, I think, not yet satisfactorily made out, but the inference from the eye symptom would be that it must be central.

Much has been written on the state of the eye caused by paralysis, from injury or otherwise, of the cervical sympathetic. So far as the pupil is concerned, observers differ only in their estimates of the degree of contraction. In physiological works, and in some clinical ones, contraction of the pupil, or paralytic myosis, is spoken of as the common condition. My own observation would rather lead to the belief that not contraction, but simply inability to dilate, is the usual condition. The pupil remains of the size usual when the eyes are in full light, and if the surgeon inspect his patient under such conditions he may easily overlook the condition. This once happened to myself. If, however, the eyes be shaded, then at once the pupil of the sound eye dilates, and, leaving its fellow motionless, a marked difference in size becomes at once conspicuous. I have examined the state of the pupil in about six examples of paralysis of the cervical trunk of the vaso-motor, and in none was its size ever less than about No. 4. In Plate XXXIV. of my *Illustrations of Clinical Surgery*, I have figured

the conditions in strong light and in shade, showing also the peculiar diminution of the palpebral fissure, which is such a remarkable feature of this lesion. In the same work (Vol. I., p. 212) I have given the particulars of several cases, and have referred to others, in which it was distinctly stated that the pupil was contracted.¹

Thus we have seen that if disorganisation of any part of the third nerve, involving the fibres of the short root of the ciliary ganglion, occur before these fibres reach the ganglion, paralytic mydriasis will result, with more or less of dilatation of pupil, total inability to contract when exposed to light, and further loss of the function of accommodation. We have seen also that if the trunk of the cervical sympathetic be disorganised, or its ocular branches at any point behind the ciliary ganglion, paralytic myosis or at any rate inability to dilate on the part of the pupil must result. These nerves travel quite apart until they reach the ganglion in question, and so far as anatomists have yet shown, they do not possess any nucleus in common. In the ciliary ganglion, however, they meet, and become closely associated, and the fibres which leave that body to pass forwards into the eye, to the iris and ciliary muscle, contain filaments of both. What would be the result of extirpation of this ganglion, or of its complete destruction by disease? Manifestly we should expect an entire paralysis of the internal muscles of the eye,—the dilator of the pupil, the constrictor of the pupil, and the ciliary muscle. The pupil would remain absolutely motionless, and the patient would be unable to read without glasses. Such cases occur, and it is to them that I propose to apply the term *ophthalmoplegia interna*. They are usually in connection with syphilis, and often both eyes suffer together. As to size of the pupil, it will vary somewhat with the age of the patient, but will, I believe, usually range from No. 4 to 6. Nothing is noticed as regards peculiarity, unless the activity of the pupil be carefully tested; but the patient will probably come under care complaining of

¹ See an important paper by Dr. William Ogle, in the *Medico-Chirurgical Transactions* for 1860; also some 'Clinical Notes on Paralysis of the Ocular Branches of the Cervical Sympathetic Nerve,' by myself, in the *Ophthalmic Hospital Reports*, Vol. V., 1866.

his imperfect vision for near objects. If there be no other symptoms excepting the ophthalmoplegia interna, I think the diagnosis of disease in the ganglion is justified, for it is scarcely possible that it can be anywhere else. We must, however, keep our minds open to a certain degree of doubt, on the score that it is just possible that at some point in the centres these two nerve twigs (part of third and part of vaso-motor) may come into relation. It is the absence of all other nerve symptoms which gives us confidence as to location; for, of course, if other parts of the third were implicated, another diagnosis as to anatomical site would become necessary.

Here, then, we have a theory of the possible occurrence of pupils sluggish to the extent of absolute immobility without central disease, and in consequence solely of disorganisation of a little peripheral ganglion. Nothing in respect to it has as yet been proved by post-mortem examination, but the suggestion is, I think, of considerable interest for the student of cerebral pathology, since pupils in this condition might easily excite suspicion of more deeply-placed disease.

Although the diagnosis of ophthalmoplegia interna may be made with most confidence when it occurs without complication, yet we must remember that it is very possibly present and in connection with the same lesion in many complicated cases. Whenever the pupil is motionless and the accommodation lost, the lenticular ganglion should be suspected, even although there may be clear evidence of disease in other and perhaps in distant parts.

(To be concluded.)

MOTOR-FEELINGS AND THE MUSCULAR SENSE.

BY GEORGE HENRY LEWES.

THE fact that we have feelings accompanying the movements of our limbs and contractions of muscles, and that such feelings are specifically distinct, is admitted on all hands; the assignment of these feelings to the motor apparatus, and their subsumption under the rubric of a Muscular Sense co-ordinate with the other Senses, is one of the vexed questions.

Muscular tissue forms the larger proportion of the tissues constituting the organism. It enters into the composition of every organ, and is so abundantly supplied with nerves that Krause affirms every single muscle fibre to have its nerve fibril.¹ This, however, would have little significance on the current hypothesis which excludes the muscle-nerves from participation in sentient phenomena, confining them to motor-phenomena. To me it has great significance, as I shall here attempt to show.

Note, first, that Motility and Sensibility are the distinguishing properties of the animal organism. Sensation always passes into motion of some kind, and all movements are stimulated and regulated by sensory excitations. We separate in abstraction these two elements of an inseparable unity; and having for analytical purposes made this ideal distinction we easily come to imagine it real. We thus separate the sensory and motor nerves, though in reality they are integrated by ganglionic substance into one nervous arc. In other words, sensory-impulse and motor-impulse are the polar aspects of one vital process. The sentient mechanism is essentially a neuro-muscular mechanism, each neural portion of it having an ingoing nerve, a central mass, and an outgoing

¹ KRAUSE, *Allgemeine und mikros. Anatomie*, 1876.

nerve, with a centripetal and centrifugal "current" of Neurility. These polar aspects represent the antithesis of passive and active; which antithesis is further extended to represent Sensation, the subjective fact, a state of the sentient organism, and Movement, the objective fact, a change in the space-relations of the body.

The psychologist must admit the presence of a motor element in every feeling; but in consequence of the tendency to classify according to marked differences, he separates the motor feelings as a class apart, precisely as he separates those of the Systemic class from those of Special Sense. In each case he throws the whole stress on what is peculiar to it, leaving out of account all that it has in common with others; thus in optical and auditory feelings only the sensibilities to light and sound are specified, without regard to the muscular sensibilities which form integrals of optical and auditory feelings. The psychologist will likewise accept a class of motor feelings such as cannot be included under any one of the Five Senses—feelings of Effort, Resistance, Movement, Fatigue, which have characters not less distinct than those of Color, Temperature, Sound, or Taste. Whether these are to be included under the general term Muscular Sense is a question of classification; whether they are in any respect assignable to the muscles and their innervation, or are simply the result of muscular contractions in exciting cutaneous and articular sensibilities, is a question of fact. On the latter point opinions are divided.¹

In meditating the arguments *pro* and *con* it has seemed to me that the phenomena have not always been recognised as very complex; at any rate one factor, or set of factors, has been urged in explanation of facts which involve many. Under the general term Muscular Sense we find included feelings derived 1° from motor impulses; 2° from motor intuitions; 3° from muscular contractions; 4° from the effects of such contractions on the skin, &c.; 5° from muscular co-ordinations;—or in

¹ The literature of this subject is enormous. In every physiological text-book there is a section on it, and in every scientific journal may be found essays on it. The reader may profitably consult BASTIAN, in the *British Medical Journal* for May, 1869; and BERNHARDT, *Archiv für Psychiatrie*, 1872.

and never of feeling, is said to be proved, because while they are known to convey central discharges to the muscles, they are incapable of conveying peripheral stimulation to the centre. This may be so, yet if so would prove nothing of the kind. But is it so? The proof offered is that when a motor nerve is stimulated, muscles move, but no sensation is excited. This is very questionable; indeed, one cannot but point to a strange oversight on the part of those who adduce this statement. They admit that muscular contractions do *somehow* cause sensations. No one disputes it; yet experiments are adduced in which muscular contractions are said not to have their invariable concomitants. What is true is, that when the motor nerve is stimulated, muscles are moved, and no indication is given by the animal of any sensation accompanying the movement. And this is intelligible. If the sensations exist at all, they must be muscular sensations, and will not therefore manifest themselves in signs of *other* sensations. When the optic nerve is stimulated, the sensation is optical, not auditory; it is that of flash, not of a pain. So when a muscle nerve is stimulated the sensation must be muscular. It is perfectly true that the muscle may be pinched, lacerated, burned, and no sign of sensation be manifested by the animal. These are not the adequate and normal modes of excitation of the motor nerve. It does not respond to them any more than the skin nerve responds to light, or the optic nerve to sound.

But, as I said, if the asserted facts were admitted, they would not carry the conclusion. We do not prove the motor nerve to be excluded from the *mechanism* of sensation by proving that it is not competent of *itself* to produce sensation. This premised, let us pass to the other argument—the *cheval de bataille* of those who uphold the essential distinction between sensory and motor nerves. A nerve is divided, thus separating from the centre the muscles to which the nerve is distributed. The portion of this divided nerve which is attached to the centre may be stimulated in any way, no sensation will be manifested; whereas, when the portion which is attached to the muscles is stimulated, these muscles move. Here, then, sensation and motion seem divorced: the more because in the

reversal of the experiment, by the division of a sensory nerve, stimulation of that portion which is attached to the centre does produce a sensation.

This negative evidence is far from decisive. If the stimulation of the motor nerve produces no appreciable change in Consciousness, this may be simply because the stimulus is not adequate and normal; for we know that inadequate stimuli leave the sensory nerves unappreciably affected. No one will conclude that the sensory nerves of the alimentary canal are insensible, because disease may eat away the membranes yet the patient be wholly unconscious of the injury. The normal and adequate stimulation of a motor nerve is the *motor impulse* discharged from its centre, and, probably, the *recurrent wave* excited by the contraction.

The outgoing impulse is admitted by all writers. The recurrent impulse is more hypothetical, and I believe I was the first writer who suggested it, and on these grounds: if we admit the Neurility of ingoing and outgoing nerves to be the same, we have no more reason to suppose that each nerve can only be excited at one end, and transmit its excitation in only one direction, than that a train of gunpowder can only be ignited at one end, and propagate its ignition in only one direction. Dubois Reymond long ago proved that each nerve conducts electricity in both directions; and the experiments of John Hunter and Bert on animal grafting prove that Neurility may be so conducted. Grafting the tail of a rat under the skin of the rat's back, the tip of the tail being inserted under the skin, its base rising into the air, is a complete inverting of the normal position; nevertheless, pinching this grafted tail produced the sensation of pain; and so accurately was this sensation localised that the rat turned round and bit the pincers. Other experiments show the same transmission in a contrary direction. Indeed, we have only to remember that the axis cylinder of the nerve is semi-liquid, to see at once that it will as readily conduct a wave in one direction as in another. Therefore I assume that when a nerve acts upon a muscle, the contraction *reacts* upon the nerve; and this gains fuller probability from the fact that between axis cylinder and contractile substance there is very considerable homo-

gency. By this reaction the motor nerve affects the centre; so that not only do the sensory nerves which are stimulated by the contractions send their ingoing influences to the centre, but, accompanying these, the motor nerves also send their recurrent influence.

Waiving this hypothetical recurrent wave in the motor nerve, we have the less-disputable elements of—1°, a sentient change in the outgoing discharge; and 2°, the change arising from the ingoing stimulation of the sensory fibres distributed to the skin and articular surfaces; and 3°, perhaps also of sensory fibres distributed to the envelopes of the muscles, and to the interstices of their bundles.¹ A muscular sensation is a complex of these sentient changes. It is composed of changes in central innervation, changes in the active state of the muscles, and changes in their organic states. It ranges through the gamut from muscle-tone to muscle-tetanus; from contractile tremors to contractions. Even when in repose the muscles are faintly quivering; this is called their tone, and may be likened to the state of the retina when in perfect darkness, which even then has what Helmholtz picturesquely calls its *luminous dust*—a kaleidoscope of colors, now deepening now brightening,—till watching it we begin to think the ancients had some justification in calling the eye the source of light. The varying tone of muscles enters as a factor in the general state of Sentience, though rarely discriminated in Consciousness. It is one main element in languor and vigour. It is a measure of the resistance opposed by muscles to the motor impulse. This resistance in turn is a stimulus, so that greater effort succeeds. When the tension in the muscles is high, nutrition having supplied a store of disposable energy, a slight impulse excites it, and the energetic contraction which ensues, reacting on the centre, gives the feeling of power and freshness so eminently

¹ The existence of sensory fibres distributed to the envelopes of muscles and penetrating through the bundles is asserted by SACHS, *Archiv für Anatomie*, 1874, p. 195; and ARNDT, *Archiv für mikros. Anat.* ix. p. 481. We must remember, however, that all methods hitherto employed for determining such questions are open to many illusions; the only decisive evidence—that of actually tracing a fibre from centre to periphery—is impossible; and the experimental evidence always involves an assumption of the main point.

pleasurable. The fresh, vigorous animal delights in exercise. The vigorous mind feels a similar delight in overcoming resistance in the combination of ideas.

Are these feelings due solely to the foldings and stretchings of the skin and to pressures on articular surfaces, when muscles are contracted? Are they due to changes in the Sensorium produced by the outgoing impulse? Each of these opinions finds eminent advocates. Let us examine them. "When a blind man," says Bell, "or a man blindfolded, stands upright, neither leaning upon nor touching aught, by what means does he maintain his erect position? The symmetry of his body is not the cause. A statue of the finest proportion must be soldered to its pedestal, or the wind will cast it down. How is it, then, that a man sustains the perpendicular posture, or inclines in the due degree towards the wind that blows upon him? It is obvious that he has a sense by which he knows the inclination of his body; and that he has a ready aptitude to adjust the parts of it, so as to correct any deviation from the perpendicular. What sense is this? He touches nothing, sees nothing; it can only be by the adjustment of the muscles that the limbs are stiffened, the body firmly balanced and kept erect. In truth, we stand by so fine an exercise of this power, and the muscles from habit are directed with so much precision, and with an effort so slight, that we do not know how we stand. But if we attempt to walk on a narrow ledge, or rest in a situation where we are in danger of falling, or balance on one foot, we become subject to apprehension; and the actions of the muscles are then, as it were, magnified, and demonstrative of the degree in which they are excited."¹ If we watch an infant learning to walk, or attend to our own sensations when learning some new muscular movement, we shall become aware of the necessity of a very fine sensibility for all these adjustments. It is only by means of guiding sensations that we can perform such actions.

There still remains the question whether the sensations derived from muscular contraction can in any degree be referred to the muscle-nerves. Schiff maintains that all the phenomena attributed to the muscular sense are due to the

¹ BELL, *On the Hand*, p. 238; 5th edition.

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foldings and stretchings of the skin when the muscles contract. Spiess and Schröder van der Kolk hold the same view. And there is much to be said for it, though, as I before intimated, all the evidence adduced in its support only proves that one among the several factors is the effect of contraction of the skin. In a paper of mine, read at the British Association in 1859, were recorded decisive experiments (reproduced in the *Physiology of Common Life*, vol. ii. pp. 284 *sq.*) showing that muscular adjustments could not be wholly due to cutaneous sensibility. These are confirmed by clinical observations of partial and even complete cutaneous anæsthesia with little or no loss of muscular feeling and co-ordination. The patients are conscious of motor impulses, and are able to co-ordinate their movements: under what conditions, and with what amount of completeness will presently be noted. A frog deprived of its skin exhibited the same co-ordinations of a complex order as a frog intact. Not only so, but a frog without its brain and without its skin, exhibited similar co-ordinating power. Nothing here remained except the mesencephalic and spinal centres, and the ingoing and outgoing nerves; but the ingoing nerves were no longer capable of being stimulated from the surface, the skin having been removed; and accordingly neither pinching, pricking, burning, nor any other irritation of the surface caused the faintest sign of sensation; if, therefore, the ingoing nerves played any part at all here, it must have been through the sensory fibres distributed to the muscles and the articular surfaces. But these could only be affected when the muscles had already been *moved*; consequently, the motor impulse carried through the outgoing nerves must have been antecedent to any passive sensation caused by ingoing nerves. This conclusion enables us to explain how even after destruction of the sensory channel, by division of the posterior roots, movement and co-ordination were still possible. I found the locomotive co-ordination still effected, not perfectly it is true, after the posterior roots of one limb were divided; and Brown-Séquard, after division of the roots of all the limbs! Such evidence is not to be gainsaid by the fact that injuries to the posterior roots, or even anæsthesia of the skin, very

seriously disturb co-ordinations in the higher animals. We are here concerned only with showing that movements *may* be effected, co-ordinated (and felt?) in the absence of the passive sensibilities which arise in the cutaneous and deep-seated nerves. Duchenne cites cases of absolute insensibility to pricking, burning, and even electrical stimulation, in patients who felt any movements their limbs might be forced to execute—felt the movements they executed themselves—felt the resistance that opposed them; in fact “chez eux la contractilité volontaire n’éprouve aucun trouble dans son action physiologique.” (*De l’électrisation localisée*, 1861, p. 425.)

Let us now, having disproved the hypothesis which assigns the phenomena to the so-called passive sensibilities due to incoming stimulation from the surface, pass to the hypothesis which assigns them to the active sensibility of the outgoing discharge. This hypothesis takes two forms, a physiological and a metaphysical. Dr. Clifford Allbutt briefly expresses the first in these terms: by muscular sense he means “the consciousness of the varying states of Neurility in the motor nerves, and of tension in the central cells connected with them.” (*British Med. Journal*, Feb. 20th, 1869.) Professor Bain expresses it thus: “The sensibility accompanying muscular movement coincides with the *outgoing* stream of nervous energy, and does not, as in the case of pure sensation, result from any influence passing inwards by incarrying or sensitive nerves.” The sensitive nerves are, he thinks, “the means by which the *organic* states of the muscle affect the mind. It does not follow that the *characteristic feeling of exerted force* should arise by an inward transmission through sensitive filaments; on the contrary, we are bound to presume that this is the concomitant of the outgoing current by which the muscles are stimulated to act.” (*Senses and the Intellect*, p. 77.) To the same effect Ludwig and Wundt, the latter establishing a distinction between innervation-feelings and muscle-feelings. (*Physiologische Psychologie*, p. 316.)

The metaphysical form of the hypothesis is that we are endowed with a “native power” of estimating the force necessary for each movement; just as we are by some philosophers believed to be born with an intuition of Space, and a “sense of

distance." In this view, Force is the direct revelation of Consciousness, which, when projected into the external world, appears as Cause. Independent of and antecedent to all experience, we know the degree of Force, or Effort, which a movement demands: this is a birthright of the Soul.

A combination of the metaphysical and physiological view may be found in Johannes Müller, who was too good a physiologist to adopt the purely metaphysical view, and too much of a metaphysician to adopt the physiological view thoroughly. "It is not certain," he says, "that the idea of the force employed in a muscular contraction depends solely on a sensation. We have a very exact notion of the quantity of nerve-force starting from the brain which is necessary to produce a certain movement." This is true, or false, according to the point of view: it is true if the notion is a *motor intuition framed out of registered experiences*—just as we have an exact idea of a circle before we draw it; an exact idea of the pain which will follow a prick, before the pin touches the skin; an exact idea of the distance of an object before we stretch our hands to seize it. But these illustrations show the error of the view which, placing the cart before the horse, supposes the notion to have been in existence *before* movements which it ideally reproduces had originally produced it. And the error becomes conspicuous in the light of clinical evidence that when there is anæsthesia the patient is utterly incapable of regulating the force. Not only does he cease to hold an object on ceasing to look at his hand, but he is so unable to regulate his muscular energy that he crushes a brittle object when he grasps it, as an infant crushes a butterfly; and if he grasps your hand, it is spasmodically—he cannot lessen the pressure at your request. The estimate of force is independent of the muscular sensation only as the idea of a circle is independent of the power of drawing it. I may have a mental vision of a human face, but my attempt to draw on paper what I thus see will be successful only in proportion to the education of my muscles. The registered experiences of former efforts have furnished me with motor intuitions; but the carrying of these into effect depends upon the motor feelings being normal—the numbness of cold, or the pain of rheumatism, will disturb the mechanism.

It seems clear that the two hypotheses of passive and active stimulations, derived through the ingoing and outgoing nerves, having both an array of evidence showing that a feeling of movement involves sensibilities of the two kinds, leave us no alternative but to include both, and not assign the feeling to either separately. The evidence proves that muscular adjustments and motor feelings may exist when there is anæsthesia of the passive sensibilities: therefore these latter cannot be the sole sources of the co-ordination and muscular feeling. But the evidence also shows that the passive sensibilities normally enter into the complex feeling, and any diminution of them is a disturbance of the co-ordination, and a variation in the quality of the feeling; the disturbance of co-ordination may be nullified to some extent by the co-operation of some other passive sensibility, notably that of sight, but nothing will nullify the variation in quality. Let us glance at the evidence.

A patient whose cutaneous sensibility is lost can supply its place. He walks steadily so long as he can "lean upon his eyes as upon crutches;" he can reach an object if he looks towards it; he can hold one so long as his attention is directed towards it. Close his eyes, and he staggers, move his arms wildly; call off his attention, and the object falls from his hand. Some patients cannot even stand when their eyes are closed. Have they then lost their muscular sensibility? This has been rashly concluded. It is disproved by the co-ordination: this certainly is not *effected*, it is only *aided*, by sight. The loss of the accustomed sensations derived from the skin has disturbed the accustomed *quality* of the complex feeling, and, although the sense of Effort remains, the sense of Effect is absent. The patient does not feel the usual consequences of a movement, and therefore does not know whether it has taken place or not, unless his sight informs him; and, since the Sensorium requires that it should be informed at each step whether the movement has been effected before it innervates the successor, a bewilderment ensues; which may be faintly appreciated by anyone studying his feelings when moving in unfamiliar places in the dark, or even when closing his eyes and trying to reach an object on the table. The movements

so accurately and unhesitatingly co-ordinated with the aid of sight, now become tentative and inappropriate. A similar case is that of the deaf man becoming dumb: no longer hearing perfectly the sounds he utters, no longer rightly informed of the effect, he first loses his power of rightly adjusting the efforts—speaking now in tones scarcely audible, and now in shouts—and, as the deafness increases, he finally loses the power of speech. It should be added that only such movements as we are accustomed to direct by sight are capable of being thus directed when there is cutaneous anæsthesia. We, who were not born blind, learn to direct our feet in dancing, and our hands in manipulations of complex kinds, by looking at them. Movements of the eyes, tongue, glottis, &c., are not thus aided. They are learned through the muscular feelings—as the pianoforte-playing of the blind is learned. But any considerable disturbance of the usual elements of a process must cause a disturbance of co-ordination. Heydt has shown, by experiment, how great a disturbance accompanies anæsthesia of the soles of the feet (*Der Tastsinn der Fuss-sohle*, 1862), but even this may be compensated by attentively watching the steps.

After giving due weight to the evidence which shows the dependence of feelings of movement on the normal influence of cutaneous sensibility—evidence we have already intimated as merely disclosing one factor,—let us now consider the other side. There are cases on record of marked defect of co-ordination where no appreciable defect in cutaneous sensibility existed. The cases, indeed, are rare;¹ I had the good fortune to study one under Prof. Friedreich at Heidelberg. The patient was a girl, about twenty, healthy in all her organic functions, and with well-nourished, powerful muscles. The sensibilities of her skin were perfectly normal, responding to every stimulus in the normal way. Her localisation of impressions was normal. She could bend or stretch arms, fingers, legs and toes at will; and the power over her muscles was such that I could not with my utmost force bend or

¹ VULPIAN says: "On a cité quelques cas très-rarés dans lesquels la sensibilité était restée intacte bien que les phénomènes d'ataxie locomotive fussent très-prononcés. Je n'ai jamais vu de cas de ce genre."—*Archives de Physiologie*, 1868, p. 148. In TROUSSEAU'S *Lectures on Clinical Medicine*, translated by BAZIRE, p. 209, two good examples are given.

straighten a limb, if she resisted me. But her co-ordination was so imperfect that she could not walk unless leaning on some one, and even then threw out her legs in a spasmodic and disorderly manner. Nor were her upper limbs more under control. If she attempted to reach an object, or to clutch one presented to her, the movements were singularly incoherent, and never succeeded until after many corrections of the effort. It took her several minutes to button her dress, though finally she always succeeded. In short, there was a great disturbance in the ordinary regulation of movements of the limbs—(those of respiration, facial expression, speech, &c., were normal),—although her skin was unaffected. I remarked to Prof. Friedreich that I had seen a frog with the sensory nerves of one limb wholly destroyed, and another with no skin at all, yet the movements in both cases were far more co-ordinated than those of this girl.

This curious example raises many questions which I cannot touch on here. It is an example of abnormal irradiation, and consequent failure of co-ordination, rather than of any absence of purely muscular feeling. The girl had muscular movements and muscular sensations, but failed to combine the movements with normal precision; the volition was normal, but there was a defect somewhere in its execution.

The experiments of Wundt (*Sinneswahrnehmungen*, p. 410) seem to prove that the muscular feelings cannot be wholly due to foldings and stretchings of the skin, or pressure of surrounding parts, in the case of the movements of the eye. The convergence and divergence of the axes, and the accommodations of the lenses, are accompanied by feelings which enable us to estimate the relative positions and distances of objects. This cannot be due to pressures: because, in the first place, the muscular sensibility is by Weber shown to be more delicate than the tactile, being indeed in the proportion of 39:40—a delicacy which rivals that of the higher senses, whereas the tactile is only 29:40; and because, in the second place, the power of estimating distance through accommodation lies within the limits of contraction; whereas, if the object, instead of approaching the eye, recedes from it, we lose all power of estimating distance when the muscles relax

instead of contracting: our estimate is then a judgment formed from the varying size of the image.

Finally, consider the marked differences in the quality of the feeling under the following circumstances: I move my fingers by a voluntary effort; you then move my fingers in the same directions, I neither opposing nor resisting the movement. In both cases the *effect* is the same—the muscular contractions, the stretchings and foldings of the skin, are the same; but in the first case there is present what is absent from the second, namely, the element of *effort*. Now suppose that I am suffering from cutaneous anaesthesia, I shall then feel the effort, but not the effect; so that unless I am looking at my fingers, I shall be unable to say whether I have moved them or not, and whether another has moved them or not. Herein we see disease analysing the two elements of a muscular feeling, active and passive, central impulse and peripheral reaction.

The Muscular Sense, to be exhaustively treated, would demand a careful survey of the facts of co-ordination and of motor intuition, which would require another essay; so that for my present purpose I must be content with the foregoing remarks. What this paper professes to show is, that although the motor sensibility is a constituent of all Feeling—since Feeling is a complex of passive reception and active discharge—there is a justification for the establishment of a special and distinct class of sensations produced by muscular movements, and for these the term Muscular Sense is appropriate. Such sensations are complexes of neuromuscular active and passive sensibilities; and although their seat is neither in muscles nor in nerves, but in the Sensorium acting on and affected by nerves and muscles, we have the same ground for including the motor nerves among the *essential conditions* of production of muscular sensations, as for including the optic and auditory nerves among the essential conditions of production of sight and sound sensations.

ON THE RÔLE OF THE DURA MATER AND ITS NERVES IN CEREBRAL TRAUMATISM.¹

BY H. DURET,

Aide de l'Anatomie de la Faculté de Médecine, Paris.
&c., &c.

THE part which irritation of the meninges, and particularly of the dura mater, may play in cerebral traumatism, forms an important subject of investigation. In lesions of the cranium and cerebral membranes, and of the subjacent cerebral cortex, the physiological action of these sensory structures may be excited. Their varied and, so to speak, protean manifestations tend at each moment to complicate the whole symptomatology, by superposing themselves in the phenomena due to lesions of the nerve centres proper.

This complication should be avoided at all hazard, and we shall endeavour to show how this can be done.

After a short anatomical sketch of the nerves of the meninges, we shall demonstrate successively that irritation of these sensory conductors may produce hyperæsthesia, pain, and reflex motor and vaso-motor disturbances, and we shall inquire whether irritation actually occurs in connection with cortical lesions, and what are its symptoms.

Sketch of the Anatomy of the Meningeal Nerves.

(A.) Nerves of the Dura mater.

Froment, Arnold, Cruveilhier, and Bonamy have given the

¹ This forms Chap. III. of M. Duret's thesis, *Sur les Traumatismes Cérébraux*, of which we have been enabled to give an analysis from unpublished advanced sheets kindly supplied us by the author. At M. Duret's desire we have extracted the above chapter in its entirety, with the exception of the details of the experiments referred to.—Editors, 'BRAIN.'

best description* of the nerves of the dura mater. These nerves all spring from the fifth pair, and are divided into anterior, middle, and posterior.

The *anterior* arise from the ethmoidal branch of the nasal, and are distributed around the ethmoidal fossa and the roof of the orbit. The *middle* spring directly from the Gasserian ganglion, and proceed outwards: "They plunge immediately into the substance of the dura mater, says Cruveilhier, *nearer the internal than the external surface*, and ramify in all directions over the temporo-sphenoidal region, and up to the parietal region of the membrane; several of the branches become lost in their course, two or three can be traced to the neighbourhood of the superior longitudinal sinus.¹

The *posterior* take their origin from the ophthalmic branch of Willis, not far from the Gasserian ganglion, cross the trochlear nerve, to which they are so closely applied, as to give rise to the idea that they spring from this nerve; and arrive at the tentorium cerebelli, where they divide into internal and external branches. The internal, two or three in number, course inwards, so as at once to gain the base of the falx cerebri, into which they pass and ascend towards the vertex. The external direct their course towards the lateral sinus, and bend so as to reach the posterior part of the falx cerebri, in which they lose themselves.

Do these nervous filaments, *which are situated nearer the inner than the outer aspect of the dura mater*, end in special terminal organs, which increase the delicacy of their sensibility? We are inclined to believe this, on account of the marked physiological troubles which ensue on their irritation.

(B.) Nerves of the Arachnoid and Pia mater:

Luschka and Bochkalek have described nerve fibres in the arachnoid. According to Kölliker, these filaments belong to the vessels of the pia mater. It is certain that a large number of the nerve fibres coming from the sympathetic accompany the carotid and vertebral arteries in the cranium.²

Purkinje and Kölliker describe nerve plexuses at the base of

¹ Cruveilhier, *Traité d'Anatomie descriptive*, 4th ed. p. 343, tome iii.

² Claude Bernard and Vulpian have demonstrated that section of the sympathetic in the neck causes dilatation of the vessels in the brain.

the cranium surrounding the arteries of the circle of Willis. Their fibrils accompany the vessels which proceed from this, and are distributed with them over the whole of the pia mater. "I have lately succeeded in following them," says Kölliker, "into the substance of the brain, as far as the vessels of ninety millimetres and less."

All these nerve fibres which accompany the arteries so far are the vaso-motor nerves of these vessels. They are the agents of the reflex vascular disturbances, of which we shall have occasion to speak so often.

II.—*Irritation of the Nerves of the Dura Mater can cause Pain.*

Van Helmont, and the physiologists of the school of Stahl, regarded the dura mater as the seat of sensation. Hence the ancient experimenters carefully investigated the sensibility of this membrane.

Haller, Zinn, Bordenave, Housset, &c., maintained that in animals this membrane may be cut or lacerated without causing signs of pain.

Lecat, on the other hand, attributed to it a sensibility more exquisite than that of the skin. Longet says that on slightly scraping the dura mater with a scalpel, towards the base of the skull and the tentorium cerebelli, the animal gives unequivocal signs of pain. According to Flourens,¹ the sensibility becomes exalted by inflammation.

Cruveilhier admitted that the dura mater was insensible to section, but that it appeared very sensible to laceration: "Having had occasion frequently to apply the trephine to the skull of dogs, I have remarked that the animal remained quiet all the time that the action of the saw was limited to the bone. But, as soon as the teeth of the instrument touched the dura mater, the animal manifested signs of acute pain by brusque movements and shrill cries."²

MM. Brown-Séquard and Vulpian do not doubt this property of the dura mater. For my own part, I have, on

¹ Longet, *Traité de Physiologie*, t. iii. p. 297.

² Cruveilhier, *Traité d'Anatomie*, t. iii. p. 343.

many occasions, confirmed the exquisite sensibility of this membrane; it is particularly shown when one seizes it between pincers, or scrapes the serous surface. A certain degree of force is necessary to affect nerve fibres situated in the substance of the fibrous tissue, but at the internal surface, slight contact is sufficient to cause pain. Certain animals utter painful cries, and do not cease for some time after the dura is pinched. In several, even where sensibility seemed abolished generally, in consequence of cerebral traumatism, I have caused *plaintes* and reflex movements by irritation of this membrane.

III.—*Irritation of the Nerves of the Dura Mater causes reflex Movements of the Muscles of Animal Life (Face, Limbs, Eyes, Pupils, &c.), and of the Muscles of Organic Life (Heart, Vessels, &c.)*

The physiological criticisms, which the theory of cerebral localisation was subjected to in its infancy, have placed this property of the dura mater in a prominent light.

Certain opponents have adduced these facts to prove that the localised movements, which are determined by the application of the electrodes on the pretended motor centres of the cortex, were in reality due to irritation of these sensory conductors. We shall not enter on the discussion; the theory of cerebral localisation has won the day.

It is now more generally admitted that the movements caused by irritation of the dura mater are reflex, and not so localised or so definite as those caused by irritation of the cortex.¹

¹ The movements produced by irritation of the dura mater are not more localised than those which follow pinching of the sciatic. According to the intensity of the mechanical stimulus, in this case, the spasms are limited to the muscles of the leg on the same side, or extend to the muscles of the opposite one, then to the trunk or upper extremities, and lastly become general. The march is similar in the case of irritation of the dura. The movements which result have never the exact localised character of the contractions caused by irritation of the cortex. The movement of cortical origin is not diffuse; it occupies a group of muscles well defined, and resembles a voluntary movement, combined, or *intentionnel*, as M. Vulpian expresses it. The same difference exists between the two orders of movements, when they seem to be limited, each to a small group of muscles, as between the closure of the eyelids on the approach of a foreign body,

But let us see what are the characters of these reflex movements. Marshall Hall¹ (*Med. Chir. Trans.*, vol. iv., 1841, p. 122) was, we believe, the first to announce that irritation of the dura mater caused convulsive reflex action. In 1872 Dalton, in his experiments before the New York Committee for inquiry into the results indicated by the physiological *localisateurs*, observed convulsions in the limbs in consequence of irritation of the dura mater in animals. But, according to him, these convulsions occurred on the same side as the irritation; whereas, when the motor centres were irritated, the convulsions occurred on the opposite side.

Carville and myself, in our experiments on the cortex, have also observed the same phenomena: and in order to avoid complication of these movements with those resulting from excitation of the motor centres, we resected the dura mater, or insulated it with a plate of glass. Nevertheless, we believe that the distinction drawn by Dalton is too precise: for frequently we observed that electrical or mechanical irritation of the dura mater produced reflex spasms and energetic movements of the opposite side, and often of the two sides, face and limbs.

Recently M. Bochefontaine has made a detailed investigation of the influence of irritation of the nerves of the dura mater on reflex movements. "The cranial dura mater is endowed with sensibility in certain parts of its extent, since irritation of these points determines, as is well known, cries of pain, and also general movements more or less energetic. But mechanical excitation of the sensitive points of the dura mater may produce, in certain conditions, movements limited to one or several parts of the body. These facts have been observed in dogs which have been submitted to experimentation for the investigation of the excitability of the cortex. The animals have been, some etherised, others chloralised by injection into the veins, and others slightly curarised; part of the cranium having been removed to expose the dura mater.

Under these conditions, if one gently scratches the dura

and the closure of the eyelids by an act of volition. The one is brusque and unequal, the other is precise and measured.

¹ *Med. Chir. Trans.*, vol. vi. 1841, p. 122.

mater with the points of the dissecting forceps, at a point situated over the middle central region, the eyelids of the same side are immediately shut. Sometimes the same excitation causes elevation of the upper lip and ear, with deviation of the nose on the side. A stronger irritation of the same sort causes simultaneous movement of the limbs on the same side; of the tail, which turns to the side of lesion, and of the face as indicated. Lastly, stimulation still more powerful, and two or three times repeated, determines movements of both sides of the face, in the neck, and in all four limbs. The movements of the limbs on the same side are more energetic than those of the opposite side.”¹

When, by incision in certain directions, the nerves of the dura mater are severed from their connections with the nerve centres in the medulla, they lose their property of producing reflex movements under the influence of mechanical stimulation (Bochefontaine).

M. Bochefontaine and myself have observed this peculiarity, that irritation of the *anterior parts* of the dura mater causes reflex movements chiefly of the eyelids and facial muscles; irritation of the *middle parts* produces more particularly movements of the ear and of the subcutaneous cranial muscles; while irritation of the *posterior parts* causes movements especially of the subhyoidan muscles and those of the back of the neck.

We have also observed very violent contractions, almost tetanic in character, in the muscles of the nape of the neck in consequence of irritation of the dura mater at its entrance into the spinal canal. The excitation of the nerves of this membrane, if it is slight, causes also *contraction* of the pupil; if it is intense or long continued, it causes *paralysis* of the iris. Lastly, we have to add, that during the same excitation we have frequently noticed nystagmus and spasms of the oculomotor muscles.

No surprise need be expressed at the extraordinary and

¹ Bochefontaine, ‘Sur quelques particularités des mouvements réflexes déterminés par l’excitation mécanique de la dure-mère crânienne’; note com. par M. Vulpian à l’Acad. des Sciences, 7 août 1876 et com. à la Soc. philomathique en *Journ. de l’Institut*, 23 août 1876.

extensive range of the reflex movements provoked by irritation of the dura mater, for two reasons, the one physiological, the other anatomical; (1) the course of the sensory impressions from the dura to the sensory centres is very short. With certain exceptions (the palm of the hand, and sole of the foot, which possess special terminal sensory organs) the less the distance between the point of irritation and the sensory centre, the greater the reaction. The rapidity and power of nerve force vary in arithmetical progression, inversely as the distance and directly as the intensity of the stimulus. Greater effects are produced by irritation of the spinal roots than by irritation of the peripheral branches or of the trunk of the sciatic. (2) Because, according to the researches of M. Pierret, Professor of the Lyons School, the centres of the trigemini occupy the whole length of the medulla, and are in intimate relation with the *centripetal* fibres which ascend from the spinal cord.¹

The nerves of the dura mater being centripetal have the properties of this set of conductors. Claude Bernard, MM. Couty and Franck have established the remarkable influence of the irritation of sensory nerves on the movements of the heart and respiration. According to the intensity of the stimulation these movements are retarded or suspended.

Cl. Bernard, Brown-Séguard, Schiff, Vulpian, &c., have shown that irritation of sensory nerves determines, locally or at a distance, vaso-motor disturbances (contraction and dilatation) often of great intensity. To this group of phenomena is given the name of *sensory vaso-motor reflexes*. "If," says M. Vulpian, in his able Treatise on the Vaso-motor Apparatus, "the central end of the cut sciatic is irritated, not only the vessels of the other limb contract, but also the most of the vessels of the body. This result is constant, and may be shown by a hamo-dynamometer in connection with one of the carotids. This apparatus indicates a notable rise in the blood pressure each time the central end of the sciatic is irritated. This elevation of pressure can only be accounted for by con-

¹ In locomotor ataxy it is not unusual to trace the lesion of the posterior columns as far as the trigeminal nuclei, of which the cells may be altered. Pierret, *Thèse de Doctorat*, Paris, 1876; et com. *l'Acad. des Sciences*, 1876.

traction of the small vessels, and by the consequent obstruction of the capillary circulation, for the effect is the same whether the vagi are cut or left intact." He adds further, "The same phenomena are also manifested under the influence of irritation of the trigeminus, and almost all sensory nerves, as well as of the posterior roots of the spinal nerves." The nerves of the dura mater, branches of the trigeminal, have analogous properties, but their influence appears to be specially exerted on the cerebral vessels. Mechanical and chemical irritation of the nerves of the dura mater cause intense vascular disturbances in the globe of the eye and corresponding cerebral hemisphere, and, often, in both eyes and both hemispheres.

I have not made any experiment with the electric stimulus. But here is an experiment which clearly shows the powerful influence of the nerves of the dura mater on the vessels of the eyes and brain. It refers to an injection of iodine between the cranium and the dura mater, by a small orifice in the cranium, chemical irritation having a more lasting effect than electrical. In this experiment are to be noted—Excessive acceleration of the respiration, contractures and dilatations of the pupils, rigidity of the extremities, occurring very soon after the injection; coma and intense vascularity of the brain: effects due to irritation of the nerves of the dura mater, for the tincture of iodine had not penetrated the membrane.

Exp. LXL.—Injection of a small quantity of tincture of iodine between the cranium and dura mater.—Excessive acceleration of the respiration.—Immediate contraction of the limbs.—Action on the pupil.—Ocular and cerebral vaso-motor disturbances.—Momentary coma.—Death.

[Experimental details omitted.]

(C.) To sum up, irritation of the nerves of the dura mater may cause: (1) Reflex spasms and contractures in the muscles of animal life (limbs, trunk, head, neck, eye-balls); (2) modifications of the respiratory and cardiac rhythm, contractions and dilatations of the pupils; (3) vaso-motor disturbances in the eye-balls, and cerebral hemispheres (hence, somnolence and coma), especially on the same side.

The knowledge of these facts has an important surgical application; for a spiculum of bone, irritating the dura mater by a sharp angle, a subosseous sanguineous clot, may cause such phenomena. In this relation the following experiment is of interest.

Exp. LXII.—Depression of the skull on the right and then on the left.—At the moment of depression, cries of pain.—Acceleration (momentary) of the respiration; contraction of the pupils.—Trepidation, and muscular spasms in the limbs.—Transitory somnolence.—Recovery.—Death by pithing.

[Details omitted.]

Remarks.

(1.) Anatomical.

These depressions, though considerable, these flat splinters, though the animal lived five days, and though they projected about one centimetre into the interior of the cranium, had not produced any lesion of the dura mater or of the subjacent hemisphere.

(2.) Physiological and symptomatological.

(1.) After the first experiment (splinter depressed by graduated blows) I observed no indication of commotion, *i.e.* no arrest of respiration, no slowing of the pulse, no tetanic phenomena, no loss of consciousness, &c., but simply *trepidations* and *spasms* of the muscles of the shoulders, first on the *same side* then on the opposite, and in the ears, *during about three quarters of an hour*. I also noticed that the animal uttered cries of pain and distress long after the shock, as if it had the sensations caused by the presence of a *foreign body*. All these facts harmonise with the researches of M. Bochefontaine and my own on the dura mater, from which it appeared to be a membrane *very sensitive*, and of which pinching or irritation provoked on the same and also on the opposite side, spasms of the muscles of the shoulders, ears, nape of the neck, face, &c. We are therefore entitled to attribute these phenomena to the irritating action of the splinter on the dura mater, rather than to affection of the subjacent cortex, since this was found quite intact after death, and inasmuch as the phenomena were

principally on the same side as the lesion. The transitory contractions and dilatations of the pupils belong also to the same category of facts.

(2.) In the second part of the experiment (depression of the left side of the skull by violent blows) all the phenomena observed are to be attributed to shock produced by violent concussion of the cranium.

They are the phenomena of cerebral commotion.

(3.) The condition of the digits and paws [intermittent rigid extension] is a phenomenon to be ascribed in all probability to the irritation of the dura mater—a reflex intermittent contraction.

(4.) The pulse and temperature were normal during the whole of the first part of the experiment, a further proof that there was no cerebral commotion.

In the second part there was a notable fall in the temperature after the shock. At 5h. 4m.: P. 46; T. R. (rectal) 39°; and a little later Resp. 13. At 5h. 20m.: P. 80; R. 17; T. R. 37.8°. The following morning (Oct. 6): P. 98; R. 19; T. R. 40°. On Oct. 7: P. 92; R. 20; T. R. 38.4°.

Cases will be referred to in the second part of this work of observations in man, where disturbances have been observed attributable to irritation of the nerves of the dura mater. In particular, M. Tillaux has communicated to me the case of a young girl, who, in consequence of irritation of the outer surface of the dura mater, exhibited contractures of her ocular muscles, and signs of cerebral congestion, such as mental hebetude, tendency to sleep, &c. She recovered completely after the cause of irritation had been removed by spontaneous opening of an abscess in the middle ear. I have already related in the Société de Biologie the remarkable case of a patient, who, in consequence of a depressed fracture of the anterior part of the parietal bone on the left side (over a non-motor region) was paralysed, by compression, on the right side. He remained profoundly comatose for three days. Now during those three days my friend and colleague, Dr. Blain (de Bernay) frequently noticed violent spasms, and even contracture of the face and limbs of the *left side*. On the fourth day Dr. Blain removed the fragments, and the patient recovered.

rapidly from his paralysis, his contractures, and his coma, which had subsisted till then. In my opinion, the paralysis on the right side—the side opposite of the lesion—was the effect of compression of the left hemisphere; but the spasm and contracture of the *left* side (the side of lesion) was the result of irritation of the dura mater by the depressed splinter. As these muscular spasms, this contracture, existed from the beginning, and could not be attributed to irritation of the cortex, since the lesion was not over a motor region, and occurred on the same side as the lesion, an indication was furnished for surgical interference. I shall relate other observations of the same kind in the second part of this work.

IV. *Relations between lesions of the dura mater and of the cortex as regards their symptomatology.*

(A.) The analysis of the lesions which we have observed in our experiments on cerebral commotion in the motor regions of the cortex, and in general in the motor centres and tracts, have shown in a conclusive manner that they manifest themselves in a perfectly constant and characteristic manner.

1. If the lesion is slight, like a superficial extravasation, an *exaltation* of the function of these centres is observed, *i.e.* muscular spasms perfectly *localised*, and corresponding to the muscular groups over which the centres preside.

2. If the lesion is deeper, if it is *destructive*, there is from the first a *localised* paralysis, the counterpart of the spasm. The greater the destruction of the centres, the more extensive the paralysis; if the whole motor region is destroyed, there is complete paralysis of the opposite side.

3. A grand generalisation may be made—viz. that *lesions of the cortex* always cause functional disorders on the *opposite side of the body*.

(B.) But, frequently, on the following days (at the earliest, twenty-four hours) *contractures* appear. This is a *secondary* symptom.

This contracture is diffuse *from its first appearance*. It appears limited to the muscles on the corresponding side, but soon becomes generalised, and affects both sides of the body.

It is not constantly more marked on the opposite side. Most account for this secondary contracture by irritation 'at a distance, the mechanism of which they do not explain. Others think it is the result of the extension of congestion and inflammation over the whole surface of the hemisphere where the lesion is situated, and sometimes to the opposite hemisphere. Some believe that the inflammatory action extends to the base and irritates excitable regions—such as the cerebral peduncles, bulb, or the cord itself.

Post-mortem examination does not always substantiate these suppositions. One does not find, on autopsy, this extension of inflammatory congestion or other forms of lesion over the whole hemisphere, or to the base, or to the opposite hemisphere. In my opinion the secondary contractures consecutive to lesions of the convexity of the hemispheres, are the result of irritation of the nerves of the dura mater. They are *reflex contractures*. Let us now prove this proposition.

1°. Certain physiological considerations favour this view. Mechanical, chemical, or physical stimulation of purely motor nerves causes spasms in the muscles in which they distribute themselves; but these stimulations must be more intense and more prolonged in order to cause a true tetanus of the limb. On the other hand, irritation of sensory nerves, or of the central end of mixed nerves, much more easily and more rapidly provoke reflex spasms, which spread, first to the muscles of the opposite side, and then to the whole body; and also easily keep the muscles in permanent contraction or tetanus.¹

When a purely motor nerve, such as the facial, is the seat of disease, it is rare to observe veritable contractures, except in acute inflammations. More frequently paralysis results. Thus in caries of the petrous portion of the temporal the first signs of the extension of inflammatory processes are fibrillary contractures, spasms, and lastly paralyses. Contractures of the face, on the contrary, occur most frequently under the influence of irritation of branches of the trigeminal, by superficial lesion of the buccal or conjunctival mucous membrane, or by slight incisions of the skin. Feeble electric stimulation of

¹ Experiments, particularly of Eckhard and Kühne.

the cortex causes localised contraction of the corresponding muscles; if it is stronger, it causes epileptiform convulsions—*i.e.* the spasms spread, but the tetanism or contracture does not occur unless the current is so intense as to spread, as I have shown, to the sensory structures of the base. Also mechanical irritation caused by superficial extravasations on the cortical motor region, pyramids, and motor regions of the fourth ventricle, cause perfectly localised contractions. On the other hand, mechanical irritation of the restiform body, of the nerves of the dura mater, or of the posterior columns, causes diffuse spasms, which rapidly become general, and which, if the irritation increases, pass into contractures or tetanism.

It follows from these considerations, that lesions of the motor regions, centres or conductors, manifest themselves by localised muscular contractions, by general spasms, under the form of epileptic attacks, or by paralyses. Lesions of the sensory fibres manifest themselves in pain, hyperæsthesia, anæsthesia, or in *reflex motor* phenomena, *i.e.* contractures or tetanic spasms.¹

2°. The nerves of the dura mater are very sensitive; they have, as we have seen, a *great reflecto-motor power*. Why not attribute to them the principal rôle in the secondary contractures which supervene on injuries of the cortex? They possess in a high degree the qualities requisite for the production of these secondary effects. On the other hand, the grey matter, under conditions of exact experiment, does not react except by contractions (*secousses*); its destruction causes localised paralyses. The cortical symptoms are always localised; the contractures are mostly diffuse and invading.

3°. Lesions of the cortex are always crossed; destruction on the right, paralysis on the left. On the contrary, the contractures which accompany cortical lesions, occur sometimes

¹ It may perhaps be objected that chronic lesions confined to the motor tracts, cause permanent contractures. But actually these contractures, in descending sclerosis, appear *slowly*, long after the paralysis, and it is possible that they are due to extension of the inflammatory process to *sensory regions*. M.M. Charcot and Pierret have demonstrated many cases of the propagation transversely of systematic lesions, particularly in locomotor ataxy. On the other hand, would it not be strange to regard lesions, the *most destructive*, of the motor strands, as the cause of exaltation of the functions of these strands?

on the one side, sometimes on the other, without any degree of constancy.¹

4°. It is further to be added that lesions *really central*, such as lesions of the centrum ovale, situated at a distance from the dura mater, are rarely followed by early rigidity, as Charcot recently observed in a discussion at the Société Anatomique. Contractures probably do not occur in cases of central lesion, unless sensory fibres are excited, either directly or indirectly, by the mechanical action of hæmorrhagic foci. So, perhaps, lesions of the posterior part of the peduncular expansion (in which Veyssières, Raymond, Carville and I have demonstrated the existence of sensory fibres, section of which causes crossed hemianæsthesia) are capable of causing this contracture. On the contrary, superficial lesions, close therefore to the dura mater, and in particular congestive lesions, are almost always accompanied by contractures.

Their action is analogous to that of congestive lesions of the conjunctiva, which so readily excite spasm in the eyelids, face, or oculo-motor muscles.—Render the globe immovable by keeping both eyes closed by soft compression with wool, and the pain and contractures cease. This analogy is the more justifiable since the hemispheres, like the eyeballs, are subject to constant expansions and contractions, and rub continually on the inner surface of the dura mater. Render the hemisphere immovable by compression, as I have frequently done; and, unless the lesions extend to the base, no contracture supervenes.

(C.) These physiological considerations nevertheless, however important they may seem, require to be supported by actual proofs. Since the nerves of the dura mater have, as we have said, this property of causing contractures, this must be proved by showing that these contractures do not occur when the dura mater is rendered insensible. Two methods of procedure suggest themselves: (1) to cut the trigeminus at its root;

¹ I do not think that it can be laid down as a rule that the contractures which depend on irritation of the dura appear constantly on the same side, while the so called contractures of cortical origin occur on the opposite side, in the limbs primarily paralysed; for irritation often causes crossed action, and it frequently happens when the nerves are pinched between the forceps that the spasms become general, or even occur primarily on the opposite side.

(2) to resect a large portion of the dura mater, and see if the cortical lesions still cause contractures. I have not attempted the first method; because section of the trigeminus is a very delicate operation, and difficult to carry out without causing lesions of the base, which might themselves cause contractures. I have therefore employed exclusively the method of resection of the dura mater over a large area. In no case in which this operation has been performed have I seen contractures occur, so long as the cortical lesion did not extend beyond the portion uncovered, or towards the base, or to the opposite hemisphere. The following is an observation of this kind.

Exp. LXIII.—Opening of the skull and resection of the dura mater over a large area.—Fixation of the brain by a plate of cork.—Phenomena of encephalitis without contracture.—Observation for twenty-one days.—At the autopsy, destruction, by encephalitis of a large portion of the hemisphere—the motor regions destroyed.

[Details omitted.]

In this experiment I resected the dura mater, and introduced a plate of cork within the cranium, causing gentle compression, so as to fix the hemisphere. During the twenty-one days of the animal's survival, under constant observation, encephalitis progressed slowly over the whole convexity of the hemisphere, and yet at no period did contracture occur. It is not, however, necessary to resect the dura mater, as fixation of the hemisphere by moderate compression is enough to prevent contracture, notwithstanding the occurrence of encephalitis. Of this the following experiment is an instance.

Exp. LXIV.—Compression of the left hemisphere by a plate of cork—Localised meningitis—Absence of contracture—Death.

[Details omitted.]

This experiment proves, therefore, that when the cerebral hemisphere is rendered immovable, encephalitis may appear and go through all its phases, without contracture occurring. In this case the nerves of the dura mater were compressed.

But this matters little in reference to the demonstration which will be given.¹

The absence of contracture is also observable in the following experiment, and in several already detailed.

Exp. LXV.—Depression of the skull on the left side—Meningitis—Absence of contracture—Recovery.

[Details omitted.]

In the cases in which, in consequence of this compression, instead of a superficial encephalitis, a diffuse phlegmonous meningitis occurs, the contracture does not show itself till late, and when the lesion has extended to the base.

When irritating injections are made into the cavity of the arachnoid, the assemblage of symptoms is very different. There are at the same time contractures dependent on irritation of the nerves of the dura mater, and paralysis due to destructive lesions of the cortex.

Exp. LXVI.—Injection of iodine into the cavity of the arachnoid—Contractures and paralyses—Pachymeningitis and destruction of the cerebral cortex.

[Details omitted.]

REMARKS.—This experiment is complex. Nevertheless, with what has already been acquired, we may analyse the groups of symptoms.

1. At first, at the moment of injection, there were phenomena of shock: viz., contraction of the limbs, ocular spasms, opisthotonus, arrest of respiration, &c. Six grammes of iodine, injected with sufficient rapidity into the cranium, are therefore sufficient to produce these symptoms. The shock was of

¹ Resection of the dura mater seems to have a notable influence on the progress of the lesions. In observation LXV., it is to be remarked that after resection of the dura mater, contracture did not supervene, until the meningitis of the convexity had ceased, and the animal had completely recovered. This is not surprising, as it is known that the nerves of the dura mater are excito-motor of the vessels of the brain, and that they keep up congestion. This is an important fact, for it seems as if resection of the dura mater had an influence on the circulatory disturbances which accompany cerebral traumatism.

short duration. Observe, however, that at the moment of injection, the contracture occurred first on the same side, and it was not for several moments after that general opisthotonus occurred. Perhaps this first phase of the contraction may be attributed to irritation of the nerves of the dura mater.

2. To the irritation of the dura mater is further to be ascribed the slight rigidity which a few minutes after the injection occurred on the right side, and also the contraction of the pupils, more marked on the right (side of injection).

3. On the contrary, the paresis of the whole left side, observed in the evening, was doubtless caused by the encephalitis of the cortex. This, as is known, has crossed action; hence paresis on the left side with encephalitic softening of the right hemisphere. The paralysis was not complete, because the cortex was only partially affected.

4. In the second period, what was the cause of the ocular convulsion? Is it a reflex phenomenon due to irritation of the nerves of the dura mater? Or is it the effect of paralysis of one of the muscles of the eyeball; paralysis caused by lesion of the posterior ocular centres of the cortex?

I am not the first to attribute the contractures seen in connection with cortical lesions to the dura mater.

Marshall Hall held the same opinion, but he brought no proof in support of his theory.

Brown-Séquard, with his accustomed genius, has long held that the phenomena which ensue on cerebral lesions are either phenomena of irritation at a distance, or paralytic phenomena. I do not understand why this celebrated physiologist, one of the pioneers of nerve pathology, has not pursued his theory and investigated the mechanism of this irritation at a distance, which consists almost always in reflex spasms and contractures.

The investigation which I have made invalidates all the more the criticisms he has lately urged against the theory of cerebral localisation. In reading his last paper in the *Archives de Physiologie*, it is easy to see that many of the cases he cites against the localisation theory are phenomena of irritation at a distance, as he still terms it, and consist in contractures hardly localised or plainly diffused. The only *troubles de*

diffusion which can be admitted, in my opinion, are the result, either of the propagation of the irritation of one motor centre of the cortex to neighbouring ones, or of the propagation by means of the fibres of the centrum ovale to the bulbo-medullary centres.

It is thus that Ferrier, Carville, and I, have produced generalised epileptiform convulsions by strong and long-continued irritation of one cortical centre.¹

The more recent researches of M. Pitres on the experimental induction of epilepsy, place beyond all doubt the propagation of irritation of the cortex to the bulbo-medullary centres, through the medium of the medullary fibres.

There exist therefore three principal modes of production of motor symptoms, by irritative lesion of the nerve centres :

1. Direct local irritation of the motor centres themselves, mechanical or pathological (small hæmorrhages on the surface, but not destroying the motor regions).

2. Secondary effects, by *irritation at a distance*, of the bulbo-medullary centres, by means of the sensory nerves of the dura mater, or other sensory parts of the hemispheres (posterior part of the internal capsule, sensory tracts or postero-superior parts of the peduncles or pons, sensory nerves at the base, restiform bodies of the medulla, posterior columns and posterior roots of the spinal cord).

3. By extension of the irritation of a cortical motor centre to others in the vicinity, or to the bulbo-medullary centres through the motor medullary fibres of the hemispheres. These last consist always in epileptiform attacks, which commence most commonly in the muscles corresponding to the centre first affected.

In his unpublished lectures, M. Charcot has already indicated these modes of causation of nervous symptoms. He suspects the influence of the nerves of the dura mater in *irritation at a distance*, but has no positive facts to give in support of this theory. He indicates very precisely the genesis of epileptiform attacks.

¹ This is another fact to prove that the cortical centres do not manifest their lesions except in muscular spasms, in cases of irritation, and in paralysis in cases of destruction.

Résumé.

The dura mater contains sensory nerves éminently excitable.

I. As is the case with all sensory nerves perhaps, irritative lesions of these nerves cause: (1) pain, hyperæsthesia, neuralgia, and reflex motor phenomena; (2) reflex spasms or contractures of the muscles of animal and organic life.

(A.) The spasms or contractures of the muscles of animal life may occur in the face, eyeballs, neck, trunk, or limbs. They occur sometimes on the one side, sometimes on the other.¹ These symptoms tend to diffuse and invade neighbouring groups of muscles.² They have never the localisation, the measured and purposed character of the contractions which belong to lesions of the cortex. They frequently become transformed into permanent contractures.

(B.) The reflex vaso-motor disturbances, due to irritation of the nerves of the dura mater, consist in spasms or congestive paralyses of the cerebral and ocular vessels, either on the same or the opposite side.

These facts are important to pathologists as they show the great influence of irritation of the nerves of the dura mater on cerebral vascular conditions, and on the organs of sense, and on the causation of secondary effects in cerebral traumatism, i.e. on the congestions and inflammations of the cerebral membranes.³

II. Destructive lesions cause local anæsthesia of the dura mater.

¹ M. Vulpian has demonstrated, in his *Physiology of the Nervous System*, that centripetal excitations do not constantly decussate in the medulla.

² It is known that in certain cases the contractures diminish during sleep, and become intensified during waking hours, and under the influence of sensory stimulation.

³ Up to the present we know nothing of sensory nerves in the pia mater. During irritation of this membrane by puncture, tearing, &c., animals exhibit no signs of pain. It is however very different, as we have shown, in regard to the dura mater. It is probable, however, that in the pia mater there are reflex vaso-motor nerves. We have described, according to Purkinje and Kölliker, the nerves which accompany the blood-vessels into the nerve tissue, but their physiological action is little known.

ON SOME SYMPTOMS OF ORGANIC BRAIN DISEASE.

BY W. R. GOWERS, M.D.,

*Assistant-Professor of Clinical Medicine in University College, Assistant-Physician
to the National Hospital for the Paralysed and Epileptic.*

I.—ON SUDDEN PARALYSIS IN CEREBRAL TUMOUR.

PARALYSIS, the result of the presence of a growth in the brain, is commonly of slow, gradual development. Such paralysis is rightly regarded as characteristic of tumour. Loss of power of sudden onset is sometimes regarded as incompatible with the diagnosis of a growth. But this is certainly incorrect. Cerebral tumour is occasionally associated with paralysis of onset as sudden as is ordinarily thought to be characteristic only of hæmorrhage or softening. In some cases this sudden paralysis is not due to the tumour—it is due to an associated vascular lesion. But in other cases such associated cause cannot be found, and the sudden paralysis appears to be the direct effect of the growth. These cases are of much pathological interest, and all are of clinical importance on account of possible errors in diagnosis. There is nothing new in the fact, but it has scarcely received the attention it deserves.

In speaking of sudden paralysis, the cases may be distinguished in which the onset of the paralysis is accompanied by a convulsion. It is very common for a convulsive attack to leave considerable weakness in the part convulsed. After an epileptic fit such weakness is transient. After a convulsion from organic disease, as tumour, it may be permanent. It is, in that case, the result of the presence of the growth

in a motor region, which means the irritative destruction of that region. The weakness resulting from the after-effects of the "discharge" may render the effect of the graver damage produced by the growth suddenly apparent. But these cases, although they may be distinguished, cannot be entirely separated from those in which the paralysis results suddenly from the direct action of the growth without convulsion.

The causes of paralysis of sudden onset in cerebral tumour may be enumerated as follows:—

Associated conditions .	Hæmorrhage into and around growth.
	Softening from (a) associated vascular disease.
	(b) Pressure on or Invasion of vessels.
Direct effects	Inhibition (?)
	Exhaustion from convulsion.

The first-mentioned cause, hæmorrhage, with growth, is one of the rarest. The condition is common, but does not occur, as a rule, until the tumour is of considerable size. The resulting hæmorrhage does not produce paralysis unless the tumour is situated in a motor region; but the growth so situated has commonly caused paralysis from its size, before the hæmorrhage occurred.

Softening, from direct invasion, and consequent obstruction, of vessel, artery or vein, is also rare. It is well known how constantly vessels escape the effects of pressure or invasion by such growths as occur within the skull.

Softening from associated and independent vascular disease is, however, a common incident in cerebral tumour. It may occur in the old, in whom chronic endarteritic changes occasionally co-exist with a growth. It occurs, however, more frequently in the young, in cases of syphilitic disease. It is exceedingly common for syphilitic disease of vessels and a syphilitic growth independently of vessels to co-exist, and each may produce its own symptoms; if the tumour is not in a motor region, there may be only headache and optic neuritis to declare it, and the only paralytic symptoms may be due to the vascular disease, and may be of instantaneous onset. The following case is an instance of the co-existence of these two conditions, and in it the sudden paralysis must, I think,

be ascribed to the vascular disease. The case is also of interest from the long interval between the primary syphilis and its latest manifestation.

T. N., a strongly-built artisan, aged 35, was first seen at the National Hospital for the Paralysed and Epileptic, on May 30. He was suffering from slight right hemiplegia, and gave the following history. Fifteen years before, he had well-marked constitutional syphilis. Four years before, after having pain in the back of his head for some weeks, he had what his wife termed a "fit," in which there was loss of consciousness for a few minutes, but no convulsion. It was followed by slight right-sided weakness, which lasted for some months, and then gradually passed away. The head-ache, however, continued, and he had occasional attacks of giddiness, in which he walked unsteadily. A year after the first, a second similar attack of loss of consciousness left him slightly weak on the right side, as did the other, but was succeeded by total, or almost total, loss of sight. He could see perfectly until the occurrence of the loss of consciousness. After four months' blindness, the sight gradually returned, but not completely. The giddiness became less marked, but the occipital headache continued until a year ago. He was pretty well until a fortnight before he came under observation, and then two convulsive attacks occurred, apparently general. After the last, control was lost over the bladder and rectum.

When first seen he seemed to understand slowly what was said to him. The expression of the face was dull and heavy. He did not speak, except when asked questions, and then sometimes remained silent and looked puzzled, at others answered them intelligibly, speaking slowly. No paralysis could be detected, either in the limbs or of any cranial nerve; but the stools and urine were passed involuntarily. Ophthalmoscopic examination showed the right optic disc to be well coloured, but clear, outline distinct; around it, however, were several white patches with soft-looking edges, over which the vessels of the retina passed without change of position or calibre. The vessels were normal. Examination of the left eye was impracticable, on account of an old injury.

Under the influence of perchloride of mercury he improved

rapidly. In a few weeks he regained control over his sphincters, and spoke in his ordinary manner. On July 1, however, he complained of general malaise, but had no headache or giddiness. Next day his wife observed his manner to be strange. On July 3, he was drowsy, sleeping most of the day; his manner was dull and listless. He spoke as usual when asked questions, but did not care to speak unless spoken to. On the following morning, July 4, his wife, on waking, found him unable to speak or to move his right arm or leg. She had noticed nothing like a convulsion in the night, and thought that she must have done so had there been one. He could not open his mouth farther than would admit the tip of a spoon, but seemed to swallow liquids without much difficulty. Next day he seemed to notice what was going on, and after a few days to understand what was said to him, but he did not speak, except that when pressed by his wife to say if he was better, he said "Better."

He was seen on July the 10th; he seemed to understand whatever was said to him, and attempted to execute any movement he was told. He could not be made to say "Yes" or "No" voluntarily. Once he uttered correctly two or three words in answer to a question. No other speech could be obtained. There was very slight paralysis of the lower part of the face on the right side, noticeable at rest and on slight movement, but disappearing on stronger movement. He could not be made to protrude his tongue, nor to contract his masseters. No paralysis of any other cranial nerve could be detected. He could not move his right arm or leg. By a strong effort to move the leg he could just contract the muscles of the right thigh. The limbs were not rigid. There was distinct hyperæsthesia of the paralysed arm and leg. Ophthalmoscopic appearances were unchanged.

In this state he continued for three days; and then, on July 14, violent convulsions came on, and recurred so frequently that his wife described them as "one continuous fit." Both sides, according to her account, were equally involved in the convulsion, both arms being very rigid. The attacks continued until his death, four days later (July 18).

At the post-mortem examination a small growth was found

in each hemisphere. That in the right hemisphere was about the size of a cherry, and situated in the lowest portion of the parietal lobe, in the supramarginal gyrus, above the posterior limb of the fissure of Sylvius. It reached but did not project from the surface of the convolution. On section it was firm, and the cut surface was uniform, greyish, and semi-translucent.

In the left hemisphere a tumour the size of a walnut existed in the inner part of the frontal lobe, about two inches from the anterior extremity of the hemisphere. It involved the grey matter of the marginal convolution, but was elsewhere situated only in the white substance of the hemisphere, which was much softened, and mottled with vessels in the vicinity of the tumour. Its surface was greyish red and translucent. On section it was very firm, having nearly the consistence of soft cartilage. The greyish-red superficial layer enclosed a central opaque greenish-yellow mass. This "cheesy" centre was irregular in shape, irregularly lobulated, the portions being separated by reddish-grey translucent tissue, continuous with that of the periphery, but of a deeper red.

On slicing the hemisphere it was seen that while the posterior third above the ventricles was firm, and presented more visible vessels than normal, the anterior two-thirds were much softer than natural, and contained very few visible vessels. The softer portion was reddish in the neighbourhood of the tumour, white in the middle of the softened portion, and yellowish behind. The walls of the lateral ventricles were quite firm. The corpus striatum and optic thalamus were perfectly healthy. The cerebellum was free from any abnormal appearance.

The vessels at the base of the brain were diseased at several points. On the left vertebral, on the side of the medulla oblongata, was a semi-opaque swelling, about half an inch in length, and in thickness about equal to the diameter of the artery. On section the thickening had only slightly diminished the calibre of the vessel. The right vertebral was larger than the left, and tortuous. The branch of the posterior inferior cerebellar artery, which runs along the anterior edge of the cerebellum, also presented a large nodule, the size of half a pea, semi-opaque, and similar in appearance to the other, and,

like it, not obliterating the artery. Another nodule of similar appearance lay in the middle of the left Sylvian fissure, being attached to the most anterior of the two arteries, into which the middle cerebral divides, and this part of the vessel was closed. Branches of the other unaffected artery, given off further on, could be seen passing onwards and forwards over part of the nodule to supply the contiguous brain substance, which presented no trace of softening.

I think that the anæmia and softening of the anterior part of the left hemisphere must be regarded as the cause of the sudden paralysis and loss of speech, and that this anæmia must be ascribed to the co-existing disease of the middle cerebral artery. No symptoms can be ascribed with certainty to the growth in the right supramarginal gyrus. The sight of the opposite eye had been long lost from injury.

There remain for consideration the still more interesting cases in which a cerebral tumour causes a sudden paralysis without there being any discoverable cause for the suddenness of the onset. Of this the following cases are examples:—

A woman, aged 53, had been suffering for about six months from headache and rheumatic pains in the chest. Twelve days before, she suddenly fell while walking, but without, according to her own account, any loss of consciousness or any giddiness. For the next seven days there was more headache and irritability, but no weakness. Then, five days before admission, she lost consciousness for three hours, and on recovering consciousness was unable to move the left arm or leg, without, however, any affection of speech. Gradually her mental state became more and more dull. When admitted into the National Hospital for the Paralysed and Epileptic, there was complete left hemiplegia and great mental dulness. She lay on her back taking no notice, making no attempt to change her position, moaning frequently. When spoken to she would not at first answer, but on the question being repeated, especially if simple (as the names of her children), she answered, commonly correctly. After one reply, it was difficult to extract another for some time. She lay in bed with head and eyes inclined a little to the right (towards a window), but they

could be turned to the left freely. There was no other affection of ocular movements. The left side of the face was distinctly weak in the lower part. There was no apparent deafness. Deglutition was unimpaired. The tongue on protrusion deviated slightly to the left.

The left arm was absolutely paralysed and slightly rigid; the rigidity increased on attempts at passive motion. The left leg was also motionless. Sensation on left side was thought to be unimpaired. The right limbs were moved freely.

A few days after admission, the right arm and leg were moved less, and gradually became motionless. Soon after the right side became powerless, the mental state became more and more dull, and she passed into a state of insensibility, lying with eyes closed and mouth open, but occasionally half opening her eyes for a short time. Nothing roused her; but if the left arm was moved, an expression of pain passed over the face. Deglutition became difficult, partly at least from her mental state, food being held in the mouth a long time before being swallowed. The comatose condition increased, and she died a month after her admission—the temperature having been normal until the last day, when it rose to 102° .¹

At the post-mortem examination, two growths were found in the brain; one, small in size, in the right corpus striatum, and a large one in the corpus callosum extending laterally into both hemispheres. The small growth measured three-quarters of an inch from before back, and five-eighths of an inch from above down. It was situated at the junction of the crus with the corpus striatum, its inner limit being just outside the optic tract, which was not, however, in any way damaged. It occupied the anterior and upper part of the radiation of the crus into the striate body. The larger growth had infiltrated the substance of the corpus callosum, so that its white substance was no longer distinguishable. Its antero-posterior extent was an inch and a quarter, the posterior extremity being two inches from the posterior extremity of the corpus callosum; the anterior margin of the growth was just behind, and did not involve the anterior curved portion of the corpus callosum. A few white

¹ The notes of the symptoms of this case were taken by Dr. W. A. Sturge.

longitudinal fibres were visible on the under surface only. On the upper surface it formed a grey prominence. In the left hemisphere it had infiltrated the white substance above the lateral ventricle, extending outwards as far as the junction of the latter with the corpus striatum, and almost to the grey substance at the bottom of the transverse frontal fissure; backwards as far as the level of the anterior extremity of the optic thalamus, and forwards as far as the level of the anterior extremity of the corpus striatum, infiltrating through this extent the white substance of the gyrus fornicatus, and to a less extent that of the marginal convolution; its anterior and vertical measurements being one inch and a quarter. In the right hemisphere its extent was smaller, its position being similar, but its antero-posterior extent only one inch, and its upper limit the calloso-marginal fissure.

The growths were uniformly soft, pinkish-grey, mottled with red dots and lines; nowhere opaque; uniform. Demarcation tolerably sharp; a little white softening outside the growth in the substance of the hemisphere. No hæmorrhage. The microscopical characters were, in each tumour, those of a glioma.

In this case we must associate the left hemiplegia with the growth in the right striate body, and the subsequent right hemiplegia, probably, with the extension into the left hemisphere of the tumour in the corpus callosum. There was nothing to account for the suddenness of the onset of the paralysis.

Another case, which I recorded a few years ago,¹ presents an equally striking case of sudden paralysis from tumour, and may be briefly recapitulated:—A man, while in fair health, lost consciousness for a short time, and afterwards slight persistent weakness of the right side was observed. Subsequently he had one or two other attacks of transient unconsciousness. Two months later he was one day found unconscious, and on recovering, in an hour or two, partial consciousness, the right arm and leg were found to be completely paralysed; he was speechless, and the action of the sphincters was involuntary. In a day or two he recovered slight power over the leg,

¹ *Path. Trans.*, vol. xxvii. p. 13.

and none over the arm. He became able to say a few words, stopping frequently from confusion, and being unable to get at the word he wanted to say. He could not name his occupation, but when it was mentioned he recognised it at once, and could then repeat the name. When he tried to speak quickly he became confused, mumbled, and could not be understood. This state continued for a fortnight. He then had a series of convulsions, epileptiform in the right side, with simultaneous co-ordinated movements in the left which struck the observers as undoubtedly "convulsive." He afterwards had fits confined to the right side, and the left limbs were motionless and apparently paralysed. Optic neuritis existed in the eyes. In this state he died. A tumour (glioma) was found in the left hemisphere, above the lateral ventricle, occupying the greater part of the superior parietal lobule, *i.e.* the parietal lobe above the intra-parietal sulcus. In the lower part of the lobule it projected above the adjacent convolutions in an area of about an inch. It extended downwards to within a quarter of an inch of the roof of the lateral ventricle, and inwards to within half an inch of the inner surface of the hemisphere. The upper extremity of the ascending parietal convolution was not involved, but was pressed upon, and narrowed by, the growth.

In this case also there was nothing to account for the sudden onset of the paralysis. In neither case was there, apparently, any initial convulsion. It is not conceivable that the sudden onset can have been the result of the pressure of the growth on, or invasion by it of, the motor tract, since such paralysis would be as gradual as the process which caused it. The sudden onset may be compared with another effect of tumour equally sudden, convulsion. Convulsion depends on the discharge of a motor centre under the irritating influence of the growth, and these facts seem to suggest that the irritation may exercise an influence on the centre, inhibiting instead of discharging it, or leading to the inhibition of the lower centres. This was the explanation suggested when the specimen from the latter case was shown (in 1875) at the Pathological Society, and in his lectures, since published, Dr. Brown-Séquard has applied a similar explanation very widely. As an

explanation of the phenomenon in question, it derives, I think, additional probability from the facts of the last case I have mentioned. In this, towards the last, there was a paralysis of the limbs on the left side as well as on the right. There was nothing to account for this but the growth in the left hemisphere: there was no evidence of any pressure exerted by it on the right hemisphere. The growth was situated in the midst of the fibres from the corpus callosum, and by its action on these may have exercised an inhibitory influence on the right centres, paralysing the left limbs. In the same manner a growth in this situation may cause, as in one case recorded,¹ convulsions beginning on the same side, in just the same manner as they had previously commenced on the opposite side.

Thus the phenomena of sudden paralysis after convulsion, and sudden paralysis without convulsion in cases of cerebral tumour, cannot be entirely separated, and the two may in some cases be conjoined as the result of the local irritation.

II.—ON SLOW INCO-ORDINATION FROM DISEASE OF THE OPTIC THALAMUS.

Many observations now attest the frequency with which lesions of the optic thalamus are associated with mobile spasm, spontaneous ("athetosis"), or in movement (slow inco-ordination). Charcot found disease of the white fibres outside the thalamus (posterior part of the internal capsule), and believed that it was the implication of these fibres which determined the symptom. In one case, however, in which jerky inco-ordination had been present, I found disease of the middle of the thalamus, not involving the capsule.² The following case is another illustration of the same condition: a spasmodic slow inco-ordination was due to a lesion nearly in the same situation.

Jane M., a married woman, aged 41, was admitted under my care into the National Hospital for Paralysis, in October, 1877,

¹ *British Medical Journal*, 1874. Dr. Buzzard, *Practitioner*, October, 1868.

² 'Athetosis and Post-hemiplegic Disorders of Movement,' *Med. Chir. Trans.* 1876.

with right hemiplegia of six months' duration. Its onset had been sudden, with transient loss of consciousness (for two or three minutes only). The attack had been preceded by much left-sided headache, frontal and occipital. A little "difficulty in getting words out" succeeded the onset: no more marked affection of speech. The arm and leg were powerless for months. She had considerable hypertrophy of the heart: no history of rheumatic fever. Owing to a mistake, her urine was not tested. On admission there was slight paralysis of the lower part of the face for emotional, none for voluntary, movements. The arm was still very weak, she could just raise the hand to the head, grasp = seven kilogrammes. The hand, when held out, was unsteady, and there was considerable irregularity in the movement of the fingers, causing slow inco-ordination, the fingers "sprawling" about. There was a little slow involuntary movement of the fingers. There was much spontaneous pain in the arm and hand. No change in sensibility was noted. A fortnight later the leg was stronger: she could walk alone, and was then sent to the country branch at Finchley. She was there found one morning unconscious. I saw her in the latter part of the day, and she was then lying on her back, incapable of being roused. There was no stertor, but a little froth was coming from her mouth. The left arm, when raised, was held for a moment, and fell gradually. The right arm and leg fell at once on being raised. When the right arm was pinched, it was moved a little. The conjunctivæ were sensitive. The eyelid closed when it was touched. The pupils were rather—not extremely—small: the left a little the larger of the two. The eyes did not quite correspond in position, and on close observation the right appeared to move while the left did not. There was no conjugate deviation. She died an hour later. From the inco-ordination of movement it was suggested that possibly the initial lesion was in the optic thalamus, and from the marked difference in the movement of the two eyes, that the ultimate lesion was in the pons. It proved to be so. A large clot lay in the substance of the pons, about the middle (from above down). It had destroyed the greater part of the left half of the pons, but many extravasations existed in the right half. The lowest

fibres (transverse) were little damaged : those from the anterior pyramids were wholly destroyed on the left side. The clot extended up to the lining membrane of the floor of the fourth ventricle just above the eminentia teres. The upper extremity was about a third of an inch from the posterior border of the corpora quadrigemina, and the lower at the level of the facial nuclei.

The left optic thalamus presented a depression on the upper surface running transversely across, in front of the posterior tubercle. On section a space was found, capable of holding half a nut, filled with ochre-yellow material, and situated nearly in the middle of the thalamus, passing inwards and backwards as far as the left anterior of the corpora quadrigemina, but in such a manner as to leave the posterior tubercle of the thalamus, and its connection with the corpora geniculata damaged. Externally it did not extend beyond the limits of the thalamus, but ended in a jagged border just to the inner side of the white bundles of the internal capsule. No other lesion could be found in the brain. The arteries of the base were normal, except the basilar, which presented some atheroma.

This case is of interest as showing, just as did the other to which I have referred, that inco-ordination of movement may result from a lesion of the optic thalamus itself, not apparently implicating the white fibres outside it. No defect of sensibility was noted; my brief notes of the case mention merely the absence of hyperæsthesia. There is some reason to regard the optic thalamus as both a sensory and a reflex centre. This function is quite in harmony with the circumstance that inco-ordination may result from the perversion or loss of its function. It is interesting to find that just as inco-ordination of movement of the legs results from damage to the tract in the cord through which the sensory fibres pass, and certainly without any correspondence with the affection of sensation, so inco-ordination seems to result from damage to the sensory ganglion of the brain, and, also, without relation to the degree of impairment of sensation. Of the cases of post-hemiplegic mobile spasm published in the paper before alluded to, six out of ten presented no impairment of sensibility.

ON BRAIN FORCING.

BY T. CLIFFORD ALLBUTT, M.A., M.D.

Physician to the Leeds Infirmary.

WHEN the Editors of 'BRAIN' sought my aid in the construction of this first number, I felt the honour they did me was not to be lightly refused; but, on the other hand, painfully aware that of late years my life had lain too much in the world to have led me to those results which are won by the patient labour of the student. From direct examination into the finer shapes of brain and nerve of late years I have become too much estranged; but I trust that observations in the field of practice may compensate, in some measure, the want of closer and more accurate research. On one subject I have long been fain to speak, for it is one in which I am exercised almost daily; moreover, I venture to hope it is not foreign to the purposes of this magazine. Almost daily I am in contention with parents and guardians, schoolmasters and schoolmistresses, clergymen and professors, youths and maidens, boys and girls, concerning the right way of building up the young brain, of ripening the adult brain, and of preserving the brain in age. Grievously ill do we take in hand to deal with this delicate member, and well is it that innate development overruns our schemes and brings the variety of natural good out of the monotony of human folly. It is dimly felt by society that the reign of bone and muscle is over, and that the reign of brain and nerve is taking its place. Even the Gibeonites now have the hydraulic ram and the steam felling-machine; the spectacled general of forces fights in his tent by click of battery and wire, and his lieutenant hoists an

ironclad by the touch of two buttons upon his waistcoat; the patient earth forgets the tread of horse and ox, and is ploughed by steam; and ere long, no doubt, our ministers will wind sermons out of barrel-organs, and our morning egg will be broken for us by a wafer of dynamite. Hence it comes that all classes are for "education!" The village grocer's son goes to a "theological college," and sits up by night over his "Evidences" with green tea in his blood and a wet cloth about his brows. The Gardener's Daughter pulls roses no more, and has become a pupil-teacher; she is chlorotic at sixteen, and broken-spirited at twenty. The country parson's son goes to a civil service or a navy "coach," is plucked in his teens, and is left to begin life again with an exhausted brain and an incurable megrim; nay, even the sons of Peers are putting on the armour of light, and are deserting the field for the counting-house. To meet this demand, colleges of all kinds and degrees spring up—middle-class seminaries, theological colleges, colleges of science, University boards;—even the old Universities themselves are stirring from their scholarly ease, are sending out missionaries *in partibus*, and are cramming the youth of twenty counties in the art of making most show with least learning. All this, in a way, no doubt, must be and should be; but so sudden a volte-face cannot be made without a wrench, and it is my desire now to see where the strain will tell, and how to perform our social evolution with the least injury to persons.

Like the vestryman of New York, who found it impossible to propose the paving of a street without allusion to the first lines of the Constitution of the United States, so I must venture to preface my essay by some reference to mental function as we find it. We may see the more clearly how to direct and combine our means of culture when we recognise its purposes. Mental philosophy is a subject in which I am little versed, but I must try in some familiar fashion to classify the aspects of nervous activity as they appear to ordinary observers. Without misleading error, and with much convenience, I may regard these activities from the following five points of view, namely, their Quality, their Quantity, their Tension, their Variety, and their Control.

By the higher quality of the brain or of a part of it, I mean that structure of cell and fibre which corresponds more widely or more intimately with outer conditions, so that by virtue of such relation the individual more readily apprehends things and conceives them. This is genius in the stricter sense. By quantity I mean the volume of nerve force given off by the brain or its parts without regard to quality of work done. By tension I mean the power in the nerve action to overcome inner or outer resistance—"nervous energy," as it is colloquially called. By variety I mean the congregation of different centres, and the weaving of mediate strands which give the possessor, not higher or wider, but a greater number of relations with outer things. In common life this is usually called versatility. By control I mean that subordination of one centre to another, whether inherited or acquired, which if of the lower to the higher results in obedience to the more permanent order of the universe. Thus a man may have a lofty, an abundant, an intense, a versatile, and a well-ruled nervous system, or he may have any measure of each of these states in various proportions. Goethe, whose life and character are so well known to us, seems to have possessed all these faculties in marvellous combination. His insight or brain quality was vast and penetrating; his stores of nervous energy were inexhaustible, burning with steadfast heat or flaming in passion; his faculties were infinite in variety, and they were under a control rarely in the world's history known to have harmonised endowments so manifold and so potent. To take in like manner a few more names by way of illustration, we may consider Lord Byron as one in whom quality and tension of nervous force were more remarkable than quantity, though this in him was not inconsiderable, and in whom variety was less manifest and control defective. Schiller again had high quality, tension and control, but was defective in endurance and in variety. In Keats we recognize quality, tension and variety in high degrees; control in less measure, and quantity in defect. His brain, inconstant in current, was worn out ere it was built up. Macaulay was, if the word be permitted to me, a remarkable "all-round" man, and presented an equable development of quality, quantity, tension, variety and control, though of course

he is not to be compared to the former examples in quality. Brougham had still less quality, but quantity in overflow and at high tension. Sir James Simpson again always seemed to me a good instance of a man lacking the higher complexities of brain, but abounding in mental force at high tension. In him also variety was striking, more striking than control. One of the most vivid instances of nervous energy at high tension to be found in modern history is perhaps Admiral Korniloff, as described by Mr. Kinglake, in the fourth volume of the cabinet edition of his *History of the Crimean War* (p. 108). He says of Korniloff: "It can hardly be shown that this chief was gifted with original genius, still less with piercing intellect; nor was Korniloff to be called precisely an enthusiast. Our knowledge of Korniloff must rest upon a perception of what people did when they felt the impulsion he gave. At a time when there seemed to be room but for despair and confusion, he took that ascendant which enabled him to bring the whole people in this place—inhabitants, soldiers, sailors—to his own heroic resolve. In a garrison town of an empire which had carried the mania of military organisation to the most preposterous lengths, all those straitened notions of rank and seniority and, in short, the whole network of the formalisms which might have been expected to hinder his command, flew away like chaff at the winnowing. By the fire of his spirit there was roused so great an energy on the part of thousands of men as has hardly been known in these times; and he so put his people in heart, that not only the depression created by defeat, but the sense of being abandoned and left for sacrifice by the evading army, was succeeded by a quick growth of warlike pride, by a wholesome ardour for the fight, by an orderly joyous activity." We may compare with this the description by the same fine hand of General Todleben, in whom quality and quantity of brain, variety of resource, and of smiling self-control, were all made efficient by high tension. Mr. Kinglake says, "Although Todleben seemed to be one to whom the very labours of fighting and of exterminating the weaker breeds of men must be an easy and delightful exertion of natural strength, he had joyous kind-looking eyes, almost ready to melt with good humour, and a

bearing and speech so frank and genial, strangers were instantly inclined to like, and very soon after to trust in him. From his looks and demeanour, it could not at all be inferred that he was a man who had devoted his mind to a science; nor imagine that his power of doing the right thing at the right time had been warped at all by long study of the engineering art." "Few men of great intellect have attained so closely what Englishmen mean by practical." How great quality and quantity of brain may fall short of achievement for lack of high tension rather than of control, must be sought in the story of Hamlet and like inventions, for, although the unhappy General Trochu is not yet quite forgotten, none such leave an enduring name. How many of us know that quiet friend unnoted of the many, unfelt by the world; whose powers of assimilating knowledge are great, whose intellect is capacious, and whose accomplishments are manifold, but whose nerve currents are of low or inconstant tension! He finishes no work, he fathoms no research, and he dies leaving but the memory of great powers wasted. Other curious instances of low tension are seen in those unhappy mortals, who conceive so truly, and have mental force in such quantity, that they spend their lives in bestowing volumes of good advice upon their fellows, but who never rouse themselves to their own work or duty. How, lastly, the greatest quality and capacity of mind, varied attainments and spiritual fire, may be spent as a sky-rocket is spent for lack of control and direction, has been the theme of moralists of all centuries, from the death of Abel to our own time. Of all endowments control is the most precious, and its nurture our most bounden duty. For a happy and useful life, perhaps control is more needful than quality, volume, variety or even tension of brain. But were not men born to us whose high qualities of brain enable them to see more deeply into the secrets of nature our progress would cease; did quantity of brain-force cease from a people, that people would lack endurance; were tension feeble, the lions would roar on in the paths of our enterprise; were self-control wanting, that which were won would hardly be won ere it was lost. Of all gifts then to be cherished and nurtured, perhaps we should place first control, as by it effort is

husbanded; perhaps of equal or scarcely of the second place comes tension; quality of brain cannot be had for the asking, and lack of quantity in individuals may be compensated by numbers. Variety, however charming, however grateful, is the least precious of these conditions of brain, and is the last which calls for nurture. How, then, are we so to wield our instruments of education as to promote the increase of control, tension and quantity without stifling quality and variety, and how are we to use these virtues in the riper man without disabling him?

Quality, as I have said, cannot be had for the asking, it is fitful in its growth, and often born out of due time. It should be favoured by the continuous inheritance of culture, but the mode of its epiphany lies in the same darkness with that developmental nîsus which lies behind the advance of life upon the globe. Inherited, as it doubtless must be, yet its arising cannot be foreseen in the span of human generation. In the past it has more often burst forth from obscurity as the Greek and Arab from the Orient, the Roman from the Latin, the Pisan, the Genoese, the Venetian from Byzantium, the Tudor English from the England of Lancaster and Plantagenet. Men of high quality do not seem, even generally, to have sprung, like Pallas, from the brain of their fathers, but conceived in the dark womb of time to have lighted upon the world in companies. How then education, by taking thought unto itself, is to breed or make men of great initiative is a hard question. It seems clear, however, that it is not to be done simply by the wedding of brain to brain, but that for its generation may be needed some barbarous and even gross admixture, some strange coition between the sons of God and the daughters of men. But that which they who govern education can do, is to give to genius and to character a free way for expansion and action. We cannot make such a man as Edwards the naturalist of Banff, and the more sad is it that such men when born to us are too often maimed or driven by circumstance and their gifts despoiled. That many mute inglorious Miltons are buried in our churchyards, I venture to doubt; the fire of a Burns is not easily hidden under a bushel, but some smaller lights may thus be quenched, and the best of

such men, like Burns himself, may be thwarted or broken in heart. Some may aver, and not without seeming of truth, that trial is to genius as the furnace to noble metal. But surely, this world will always offer to its children a front stern enough for their chastisement, and a law hard enough for their contrition—there needs not the imposition of fetters of ours, nor the devices of our caprice or austerity. One born before his time, in the inertia of his own generation, will find resistance enough to try his steel. Moreover, as I have said, great quality of brain may not be associated to high tension, and a moderate resistance may be fatal to achievement. A man may not be a Luther, a Cromwell, or a Knox, but he may be a Melancthon, a Cranmer, or a Wishart, and in favouring days may do the work which was done by the former in virtue of high tension as well as of genius. It is too certain, on the other hand, that by stress of circumstance zeal may be turned into fierceness, reason into tyranny, and strength into brutality; it is well, therefore, we should see that in our scheme of education we are mindful of two things:—First, that we secure perfect freedom for the individual, and toleration for all opinions, and this must be done partly by the repeal of all legal privilege and partly by the gradual enlightenment of societies: secondly, that in our scheme of education we give the means of it to all, and full play to individual gifts—not promoting a dull uniformity, nor pinching back the buds of mental growth; nor, on the other hand, forgetting that as great men often appear in unpromising times, so great gifts in the individual are often long in showing themselves. The early dunce often ripens into the later genius. I find this late unfolding of greater gifts, though by no means universal or perhaps even general, yet is so common that as a teacher I have schooled myself into much sympathy with dunces. An observant master may detect the pushing germs beneath the immobile surface of his pupil's mind, but such masters are rare, and perhaps nothing is lost by leaving their quickening to kindly time. Our duty is meanwhile not to harass or exhaust the brain prematurely by anxious culture, by stimulant or by systematic forcing. Few men can look back upon their early companionships without seeing, with a feeling akin

to surprise, how the race has not always been to the swift, nor the battle to those who were strong.

"Another race hath been, and other palms are won."

Quality of brain, then, cannot be made nor forced; consisting, moreover, as it probably does, in added ganglionic and commissural structure, it, like all more complex growth, will be late in the bud and later in the bloom. And in pointing this out it must be remembered that we are speaking not only of the rarer forms of genius, but also of character—of that which gives to each person his individual colour and value. Quality of brain may, however, be lost if it is not invigorated and impelled by a strong breeze of nervous energy; nay, as in the case of the late Sir James Simpson, dauntless and inexhaustible nerve quantity may so elevate the spirit and so strengthen the hand as to clothe the individual with a power beside that of genius itself, and urge him to work which will win the undying gratitude of men. Now happily quantity, unlike quality, of brain force is much under the power of education. Quantity may be conceived as lying partly in the bulk of the nerve cells themselves, and partly in the volume of their vessels; partly also in the virtue of the blood itself. It cannot be forgotten that the health of the brain and nervous system, upon which the abundance of its fruit depends, is closely related to the tone and activity of the rest of the corporeal frame. The volume of force issuing from the brain is largely dependent, for example, upon the power of the stomach and allied viscera, upon the power of rapidly digesting and assimilating an abundance of food, and of breaking up and excreting spent material. A dyspeptic may well have nerve force of high quality, and of high tension; but I never met with a dyspeptic whose nerve force welled continuously forth. Like Brougham and Cavour, men of great power of continuous work have usually been large as well as sound eaters. A "hard-headed" man is also a hard-bodied man, and the national history of Europe is a long display of the successive triumphs of the men of colder over the men of warmer regions; of the hardy, lusty and hungry races over the softer, more indolent and more abstemious. Northern drunkenness is a survival of Northern feasting and Northern

proh; and the hearty Bishop of Peterborough touched a deep truth when he said he had liefer Englishmen to be drunkards than slaves. It is quantity then, rather than other conditions of nerve power, which is favoured by "physical education," quantity without which quality may flag; but quality is also indirectly increased, for quality is born doubtless out of the fountains of quantity. If it be true that the sons of genius are often fools, the explanation may be that the parent has spent his great fortune of intellect and passion, and transmitted to his offspring a sapless and atonic brain. It may be true also that as from the lesser robustness of women the streams of vitality in them are more slender and less perennial, so the buddings of higher genius in them are fewer and less fertile. The weaving of the higher thought and emotion is found in our experience, even of individuals, to be especially exhausting, and apt, therefore, to alternate in its function with hours of indolence, and even of depression. The greatest master cannot be unconscious of these tides in his creative work, and the lesser, seeking relief and distraction between whiles, drifts into the "Bohemian." To secure then quantity of nerve force directly, and quality indirectly, the encouragement of bodily vigour and sturdy grain is fundamentally necessary. Without wealth of bone and blood volume of nerve force will dwindle, and the rarest quality may fail of proof, or lose its splendour. Before women can hope to do hard and high work, sense must expel sensibility, and school-girls must cease to walk out in a row, to veil their faces, to wear stays and to eat delicately.¹ Nay, if a certain ruggedness be not foreign to mental strength and growth, it may be that women, as a class, if they will excel in originality and endurance, must cease, as a class, to seek after the charms of daintiness and sentiment.

I am not therefore of those who think that the love of athletics is as yet in excess. Here and there men may expend in the hunting-field or on the river that which should have been given to their tripos, to their profession or to their country; yet this at worst is but an individual loss far out-

¹ In the Girls' High School at Leeds, a well-managed school in many respects, the girls are at work from breakfast to dinner and after dinner, with no interval for digestion, till four—for much of the year, that is, during all the daytime. Their cheeks know not wind nor sunshine.

weighed by the impulse given to the hardy, hungry vitality by which the nation thrives and its general volume of nervous force is augmented. Again, it is an old truth that in youth production and growth or development are in a measure opponent. The gardener, the stockbreeder, the trainer all know this and act upon the rule. The spontaneous and equable play of all sides of life favours growth and tone, but to enter the colt for the race, to bloom and seed the young plant or to put the young male to the stud is to stint their growth and to exhaust their vigour. Precocity is gained at the cost of feeble maturity and early decay. And yet can the young brain grow, cell add itself to cell, and fibre knit itself to fibre without work and play? Can the slack sinew be braced, or the muscle which is idle be increased? To this I would reply that the activity which feeds the waxing strand and ganglion is rather receptive than productive.¹ It is easy to forget how the child and the youth drink in knowledge and virtue imperceptibly as the green leaves spread themselves and feed upon the air. By an equable tide flowing in from every side, by the channels of the senses, by the universal surface of the skin, the inner chambers of the nervous system are expanded and stored with riches for future profusion. The mischief done daily by calling upon the unripe brain for productive work, for original composition,² for competitive examinations, for teaching and even for preaching, is calamitous, and the evil is increasing. The impatient examinations of young children are as injurious and as foolish as the searching of the roots of the pushing plant. Cram again is that which secures the immediate production of brain results rather than the growth of the brain itself, and it must be thrusting itself upon the vision of all but the moon-struck, that young men who are prize-winners at the ages even of eighteen or twenty years have too often spent their brains before the natural yielding-time. Too often the star of his year is quenched ere his course be well begun, and if his life be not thenceforth a failure it may fall far short of its early promise,

¹ That receptiveness of brain, its play and its productiveness are but various degrees of function I do not forget, but few differences of degree are more clearly distinguishable.

² I believe in many schools mere children are ordered to write "original" essay on set subjects.

and the brain which might have been year by year more flexible, more potent and more enterprising is warped, stiffened and staled. Such young men are now sent into the world in numbers, with minds orderly, trim and garnished, but without *élan* and without initiative—admirable clerks and formalists—but as men of action spoiled for ever. Pupil teachers again present a curious subject for observation, and a sad one. Called upon as children to teach children their brains turn backward, or stop at the stage they have attained, and the living stream of thought is congealed into a dead dogmatism. Their minds, no longer open to the dew of knowledge from above, are bent to the work of churning vapid juices for yet callower nurslings. Nor is this all: the striving and jaded brain sucks the kindly saps from the rest of the body, and the weaker sex more especially tend in their years of puberty to become pallid and enfeebled, or to break down altogether between the rival claims of mind and body. Other cases, of which my notebooks are full, are those in which brain power is run low in youth by the untimely pressure of business and of heavy responsibilities. A father dies, leaving his son, aged twenty or less, to carry on a large business, to pay his mother and sisters out of the concern, and to educate his younger brothers. Staunch to the backbone the lad throws himself ardently into life, carries at twenty years the burdens of forty, pushes onwards upon excitement and in ignorance of the mischief doing, labours for a few years or more according to his stores, and falls to pieces ere middle life is reached, and when his powers should be at their best. We label their cases "dyspepsia," "nervous debility," "mental disease," and the like: I refrain from giving scores of them. But most disastrous, perhaps, of all means of dissipating the stores of the unformed brain are the preaching tasks of the theological colleges, and especially of the Nonconformist colleges. These colleges are filled with young men—ambitious, of generous impulses and fervent temper; and their teachers, as seems curiously true of schoolmasters as a class, are utterly unconscious of the existence of the science of physiology. These hapless lads are not only spurred on to intense and prolonged study during the week, but are called upon to preach. I do

not mean that they are merely taught to use the voice and gesture which are the instruments of oratory, but they are actually set up to address congregations of people. I will say nothing of those hearers who find edification in the raw dogmatism of an undergraduate, or spiritual increase in the forced and jejune exhortations of striplings to whom spiritual experience is yet unknown; but I will say of the prentice preachers themselves that the system is immeasurably cruel. A luckless youth is forced to heat the yet empty chambers of his brain, and to forge false thunder therein at an age when he needs rather to sit at the feet of wisdom. Space forbids me to give instances from my books, but the facts are open to others as to myself. Men whose steps are faltering upon the very threshold of the ministry come to me lamenting that the hope and the fervour, the peace and the joy of their initiation have fled, and in their place are listlessness, weariness, confusion of mind—nay, even satiety and disgust. Their teachers urge them to drown their reaction in more work, and in unhealthy self-examinations. Pallid, dyspeptic, peevish, sleepless, disheartened, many of them creep into orders to come in later years to the physicians, almost cursing themselves because their labours are unfruitful, because they cannot sit down to think nor stand up to pray. The explanation is too clear. The brain has been forced, and has borne insipid fruit out of due season. It may never recover its tone, or recover it only after a long season of rest. It is sad to think how many young ministers have come to me alone with such a history—men otherwise of promise, but whose best efforts have been but as the crackling of thorns under the pot. We do not realize how long a time the exhausted brain takes to recover itself! A young physician may boldly tell the overtaxed merchant or student to take three months' rest; but probably three months must be added to that, and even six months again to the sum before any degree of stability is regained. It is nearly always true that a case of brain exhaustion needs what may seem a disproportionate time to get well. Repair in so delicate an organ is slow, and we know that gardeners and breeders would rather start afresh with young stock than nurse round specimens which have been checked. Yet Englishmen are coura-

geous and enduring, and many fight into the ministry without consciousness of harm. Nevertheless, I would ask concerning even these if there be found in them any lack of quick and exquisite thought, of keen and catholic vision, of deep and tender passion; or if there be in them any delight in phrases, and any shrinking from realities; any bondage to convention and prejudice, any blenching from the service of perfect freedom, whether the forcing and hustling of their brains in earlier life have not straitened their conceptions, and checked their mental sweetness, freshness and enterprise.

Another kind of premature brain forcing is seen in young artists. Young musicians, especially, abandon themselves with perfervid ingenuity, not merely to discipline and culture, but also to original composition and to excessive display. Hence, as the passion of music is of early manifestation, and the vanity of parents insatiable, we find the history of musicians is one long wail over brilliant promise and early exhaustion or death. It is as true of music as of every other art, that its greatest works are works not of youth but of manhood, not of tender age but of maturity. Schubert died at the age of 31, Mendelssohn at the age of 36, Mozart at the age of 36—these, like many other masters prodigiously, even wastefully, productive in the days of their spring, were worn out when their transcendent genius should have borne its harvest. Even in music we find the most lustrous and immortal works were the works not of youth, nor of early manhood, but of riper years; of masters who were endowed with inexhaustible wellsprings of force in body and brain, or who had husbanded their stores in earlier days. Handel composed his great oratorios after he had passed his fiftieth year. Sebastian Bach wrote the B Minor Mass at the age of 48, and the two Passions somewhat later still. Beethoven wrote the A Major Symphony and the Eroica between the ages of 34 and 44: he had thus reached formal excellence, and had he then died would, like Mendelssohn, have bequeathed a great name to posterity. Happily he lived on to write his grandest works, such as the Ninth Symphony and the Missa Solennis, after the age of 45. If we turn to our own day and regard the life of a genius who, in quality and quantity of brain-activity with

tremendous tension and infinite variety, occupies a position perhaps unique—I speak of Richard Wagner—we find he was born at Leipzig in the year 1813, and is now therefore 65 years of age, so that Lohengrin and the King des Nibelungen are the works of years more than mature. I will not pursue this argument with the other creative arts, nor stay to prove that works like the *Paradise Lost*, the *Divina Commedia*, and the *Tempest* are works not of youth but of age.¹

I must pass on to consider brain work under the head of tension. Tension, I believe, depends in some way upon the tides of the blood-vessels—upon their rapidity perhaps—and more especially upon the rapid distribution of blood in particular directions. It may well be a matter of the *nervi vasorum*. Probably also some relation of capillary to cell, which favours rapid absorption, enters into the matter; for we see that tension diminishes with age—with the susceptibility of nerve and arteriole. It is a factor of infinite value to the man. “Learning,” says Falstaff, “is a mere hoard of gold kept by a devil till sack commences it and sets it in act and use” (H. IV. B. iv. 3). We may regard tension under several aspects, as in the keen tenacity of intellectual work in such a master as Newton, when it is associated with lofty and powerful control; or again in vivacious temperaments where control is often less complete. In those “whom Englishmen delight to call practical” we see it associated with dexterity, with readiness of resource, and with keenness of the special senses. This invaluable attribute is happily much under the influence of education. Compare, for instance, the slow wit of the rustic with the mental alertness of the “jolly prentis of Chepe.” Education can not only instruct the mind, but can make it apprehensive, nimble and even fiery. “It is of no use to know a thing,” we often say to our bedside

¹ The visitor who has lately returned from the magic show of Turner Drawings now in Bond Street, will doubtless remember Mr. Ruskin's words on the opening page of his Guide, wherein he says of Turner, “He produced no work of importance till he was past twenty,—working constantly, from the day he could hold a pencil, in steady studentship, with gradually increasing intelligence.” Of the Master's work done between the ages of fifty-five and sixty-five, Mr. Ruskin says (p. 9), “In this period he produces his most wonderful work in his own special manner,—in the perfect pieces of it, insuperable.” In the Slade School at Kensington subjects are given out for original work, a system which, in my judgment, is more likely to do harm than good.

students, "unless you can deliver yourself of your knowledge." The brain must not be a silent receptacle, but, to use the old phrase, must be a "copious promptuary" of learning and device. In this paragraph then we take not the contrary, but the converse of the former, and while remembering that quantity and quality of nerve force are diminished by calling upon the tender brain for production, tension, on the other hand, is promoted by busying the student with his work, and by stimulating him with a sense of his duties and of his just ambitions. Hence class tests and even class competitions and the due use of the spur are to be encouraged so far as they favour readiness, quick and accurate observation, and modest rivalries, but not so far as to call for "original compositions," for heated and straining effort, or for the rapid disgorgement of bolted and undigested bookwork. Tension then is an endowment of nature or is increased by education and example, and especially by the personal influence of an earnest and practical teacher, and by the informing of eye and hand rather than by the straining of thought and memory. Unlike quantity, tension is not immediately dependent upon physical health. Neuralgic and dyspeptic persons often possess this virtue in high degree, and indeed fasting is said by spiritual teachers to intensify mental action. If quantity, however, be not added to tension, great passion or great action is followed by utter exhaustion and depression; and where high mettle and enduring force are combined, we obtain the greatest results. Certain drugs, such as strychnine, have the property of heightening the tension of nerve, and others, such as iron and cod-liver oil, of enriching it in quantity. In the combination of the two kinds we have the most precious medicines. The so-called "nervous children"—products of a later civilisation—need especially the benefits of quantity and control, and intelligent parents secure this by restraining scholastic pressure, by enforcing a regular discipline, and by encouraging physical development.

That endowment which I have called Variety or versatility is also partly innate and partly acquired, but chiefly innate.¹ It must consist in the accretion of a greater number of ganglia

¹ Diderot is the most brilliant instance of the Various man I can at present call to mind.

and of interweaving fibres. This is not unfavourable to quantity of nerve force, but perhaps it is unfavourable to the quality or high development of special ganglionic groups, and also to tenacity or steadfast intensity. The schoolmaster therefore abhors versatility, and that greater schoolmaster, the world, grinds it to dust. Without variety the pedant loses the sense of the infinite interests and conditions of life; with variety and without penetration the *dilettante* is ignorant of the depths of his own ignorance. The pedant denies that any knowledge should be taken in small quantities, the *dilettante* is repelled by the isolation of limited research. It would seem to be the aim of good education to insist upon a mastery of one or more subjects, that the grown man should be able to fight with the foremost, to concentrate his powers and to realize what knowledge is, but that at the same time he should gain some not inadequate notion of the whole field of the battle of life. He will thus gain in sympathy and flexibility of mind, while he is saved from the "failing of omniscience." A happy citizen of the republic of learning must have culture at once liberal and profound, at once general and special; to such an one a little knowledge is no longer a dangerous thing.

Finally, Control is partly innate, but greatly the creature of education. It is, I believe, the earliest work of education, the safest work and the most abiding. As an innate virtue it consists, no doubt, in the superposition of more complex or higher centres upon the lower and upon the weaving of these together by commissures of various orders. These ganglia and fibres, sketched out as it were by inheritance, are nourished and developed by use, i.e. by education. By use lines of least resistance are established, and thus habits are formed. A man cannot bite his nails without fingers and teeth, nor can habits be formed in the mind without the pre-existence of conflicting ganglia, but it is infinitely important to test the child for their presence and to set up in them certain lines of movement, and certain coincident memories or "associations." Thus also appears the Will, that is the revelation to consciousness of the balancing of the faculties, though where consciousness enters, we know not, and shall never know on this side of the grave. No mistake, then, is more fatal than that of parents who let

children run wild on the pretence of physical development. This, indeed, they may obtain, and how guarded we are to be in forcing the brain I need not say again, but there can be no misfortune to a child greater than to escape the life of justice, order and rule, or to escape the training of those perceptions of social needs and social laws which when graven in our ganglia and long current in our nerves become habits of sympathy, charity and self-sacrifice. Herein I fear that the partisans of "secular" education are greatly at fault. Children may be trained in Board schools to habits of cleanliness and order, but they are not trained in the principles of liberty, nor are their eyes turned to the sanctions of religion. From this system I fear there may be a sad awakening for a coming generation. I may sum up thus:—The powers of the nervous system with which education is chiefly concerned are Quality, Quantity, Tension, Variety and Control. Quality is beyond the direct efforts of education, its rarer development, both in nations and individuals, is as yet incalculable; in the early life of the individual it is often latent, and its greatest results belong to years of maturity. On the other hand education may often overlay it, thwart it or expend it, and as quality is largely dependent upon quantity or volume of nerve force, the ripening of those degrees of it which exist in ordinary men, and the favouring of those revelations of it which occur more rarely, are constantly prevented by brain forcing in early life. In men of great quality or genius such brain forcing has too often dimmed or blighted the splendour of their work, or has shortened their days, and has only failed to do so in others by virtue of their perennial springs of inward energy. Quantity therefore is a very fruitful possession, and, unlike quality, may be directly reinforced by wholesome conditions—by physical education, and by the promotion of healthy and rapid digestion, assimilation and excretion. Tension is a virtue without which quality and quantity of nerve force may be wasted. By it men overcome resistance, and are fired with impulse. Promptness, alertness and acute sense come also of this attribute. Tension may be increased greatly by education, and it springs up in the busier contentions of men. It is largely independent of physical

health and of food, but is favoured by action and the training of observation. Variety, by which men are enabled to touch the world at many points, can be favoured by education. If in excess it results in aimless dissipation of energy; if duly consorted with full knowledge of one or more subjects it gives breadth and flexibility to the intellect and promotes the happiness of personal and social life; it favours general progress by permitting the more rapid diffusion of the knowledge won by the few. Lastly, control is eminently a creature of education, and is perhaps the most precious gift of the individual man. Without justice, temperance and definite industry the most brilliant attributes of mind may be impotent for good, and without the habit of social subordination and the bond of social sympathy the most brilliant society would be but a rope of diamonds. Brain forcing is terribly mischievous. It urges genius into precocious fruitage, it drains the springs of nervous force, it excites high tension without giving volume to fortify it, it stints the variety of mental expansion, and by enforcing control it breaks the spirit. The true purpose of education is first of all to teach discipline—the discipline of the body, and the higher discipline of the mind and heart; to encourage the budding faculties to break freely in natural variety; to quicken the eye and the hand, and to touch the lips with fire; to promote the gathering of the fountains of vigorous life by fresh air, simple nutritious diet and physical exercise; and finally to watch for the growth, silent it may be for years, of the higher qualities of character, or even of genius, not forcing them into heated and froward activity, but rather restraining the temptation to early production, and waiting for the mellowness of time: remembering that the human mind is not an artificial structure, but a natural growth; irregular, nay, even inconsistent, as such growths are, wanting most often the symmetry and preciseness of artifice, but having the secret of permanence and adaptability. These words seem almost too simple—these truths too obvious for repetition, yet for lack of that which lies in them our modern schemes of education are day after day ruining the young by overstimulation and unhealthy competition. Happily the public is awaking to its error, and is beginning to regret the days when

its young dunces grew into its old heroes. What we did blindly in the past by trusting to the hidden wealth of nature, we may now do face to face by the revelation of her secrets.

P.S.—Since this essay was prepared for the printer, I have received the February number of the *Fortnightly Review*, which contains an article by Professor Huxley on Technical Education. In that article Mr. Huxley expresses opinions which must command general attention and adhesion. Although his argument is sped with thought and word far stronger and swifter than mine, and clothed with an authority to which I can lay no claim, yet I may perhaps without presumption call myself a fellow-labourer in the same field.

ON THE COMPARATIVE STRUCTURE OF THE CORTEX CEREBRI.

BY BEVAN LEWIS, F.R.M.S.,

Pathologist and Assistant Medical Officer to the West Biding Asylum.

A CONJOINT article by the writer and a fellow-worker in the field of cerebral histology was communicated last January to the Royal Society,¹ in which was given a detailed account of their researches into the intimate structure and lamination of a limited region of the cortex in the human brain. The region to which their enquiries had been limited was a large extent of that portion of the cortex which is regarded as *motor* by Ferrier. Since the former article was written, a further and more complete examination of the motor area in man, and the regions bordering upon it, has been made by the author of the present communication; and, further, the cortex of the motor area in the cat, and certain regions in the brain of the sheep, have been subjected to examination. It is proposed to give in these pages a résumé of the former paper, together with the results of later research.

Types of Structural Lamination.

Of the five distinct plans upon which the architecture of the cortex cerebri is framed according to Meynert, that lamination stated to be characteristic of the vault has been the subject of some dissension. Meynert² distinctly affirms that

¹ *Proceedings Roy. Soc.*, 'On the Cortical Lamination of the Motor Area of the Brain,' by Bevan Lewis and Henry Clarke.

² 'The Brain of Mammals,' by Theodore Meynert (Stricker's *Human and Comparative Histology*, vol. ii. p. 381).

this formation is five-laminated, in which statement he is supported by Mierzejewski¹ and Betz.² Baillarger³ adopts a different view regarding the lamination typical of this region as consisting of six layers. Dr. Major⁴ agrees with these views of Baillarger, and extends the limits of the six-laminated cortex to the central lobe or insula. Our researches, however, demonstrate that each of the disputants is correct only in a limited sense. There is a five and a six-laminated cortex, each typical of a certain definite area; but, whilst the six-layered formation is found extensively spread over the convolutions of the parietal and other regions, the *five-laminated* type is pre-eminently characteristic of the motor area of the brain. Another highly important feature of this region is the presence of large ganglionic cells which under the title of "giant cells" were made the subject of special attention by Professor Betz over three years ago.⁵ Our examinations tend to convince us that these cells have a motor significance, and that in their configuration, size, and distribution, they present us with a thoroughly unique formation. These great elements are constituents of the fourth cortical layer; and as the question with regard to lamination centres around the mid-regions of the cortex, this fourth layer will necessarily share the larger amount of our attention.

Individual Layers in the Motor Area.

As regards the three upper layers described in detail in the original article, it may be briefly stated that the authors are at one with most observers. We, however, regard the cellular elements of the first layer as wholly non-nervous, and class them as connective and perivascular cells. The nerve cells of the second layer are continued in small numbers down through the whole depth of the subjacent striatum, the smaller pyramids lying side by side with the greater pyramidal cells of this

¹ 'Études sur les Lésions Cérébrales dans la Paralyse Générale,' *Archives de Physiol.*, 1875.

² 'Gehirncentra.' Betz, *Centralblatt f. d. Med. Wissensch.* Aug. 1874.

³ Baillarger, 'Structure de la Couche Corticale.'

⁴ 'Histology of the Island of Reil,' *West Riding Asylum Med. Reports*, vol. vi. Op. cit.

formation. The fourth layer was found to constitute a narrow belt, readily recognised in fresh sections, as a pale white streak about midway down the cortex. In this layer we found the small angular cells described by Meynert scattered amongst a belt of large ganglionic cells. It is important to distinguish these angular elements from the small pyramidal bodies characteristic of the second layer for the following reason. It was stated above that these small pyramidal cells are found sparsely scattered through the whole depth of the third layer. Now, in certain regions of the brain these cells tend to aggregate towards the lower limits of the third layer, and eventually form betwixt it and the ganglionic series, a distinct and dense stratum of cells. Approaching closely as they do the neighbourhood of the true angular cells, and differing but slightly from them in dimensions, they may readily be confounded with them, unless attention be directed to the well-founded criterion given by Meynert, in referring to the angular elements as "rarely triangular or elongated in a direction parallel to the radial fasciculi."¹ In those portions of the ascending frontal, and first and second frontal convolutions which are *par excellence* supposed to possess motor endowments, we find the fourth layer consists of a belt of these angular elements, subdivided by the ganglionic series of cells; hence the latter have angular cells above, around, and below them. We have on this account felt disposed to term this fourth layer the mixed or ganglionic layer, as its order in cortical lamination varies in different regions, and hence the demand for a more distinctive term. We shall now proceed to a more minute inquiry into the general characters presented by the large ganglionic formation in these regions.

Ganglionic Cells of the Fourth Layer.

I. *Form.*—The pyramidal form is frequently seen, whilst a plump body elongated towards either pole, so as to approach somewhat the fusiform, is a very typical variety. On the other hand, the truly fusiform or bi-polar cell is rarely met with. The great irregularity in marginal conformation is attributable,

¹ Op. cit., p. 389.

in a great degree, to the extension of the protoplasm of the cell to some distance up the numerous branches. Each cell contains a large round or oval nucleus within which a nucleolus can always be demonstrated. These cells are peculiarly prone to pigmentation.

II. *Size*.—The measurement of a large number of these cells from a limited area on the ascending frontal gyrus gave an average length of $60\ \mu$, an average diameter of $25\ \mu$; the extremes being $30\ \mu$ and $96\ \mu$ for length, $12\ \mu$ and $45\ \mu$ for breadth. Taking a very large selection of cells from *various points* of this convolution, we found the average measurement to be $71\ \mu \times 35\ \mu$. The largest cell met with measured $126\ \mu \times 55\ \mu$.¹ The dimensions of the nucleus were $13\ \mu \times 9\ \mu$. (The *micromillimeter* (μ) = .001 of a millimeter.)

III. *Processes*.—The average number of secondary processes was seven, the largest number fifteen.² Sections taken across the long axis of the cell exhibited the cell as the centre of an extensive area over which its branches spread, radiating outwards and downwards from all points of its margin. In these sections as many as eighteen branches might be detected occasionally. This being the mode of branching, it will be readily apparent that the absolute number of processes cannot be determined with any degree of certainty.

IV. *Distribution*.—The results of our examination on this point has been to demonstrate the very important fact that these ganglionic cells occupy certain *definite areas* remarkably constant in position; and it appears to us that these large *cell-groupings* are especially and exclusively a characteristic feature of the motor area, as defined by Ferrier. The authors do not question the fact that ganglionic cells of smaller size are found distributed over the cortex at a distance from this region of the motor centres; but we have never found in these latter realms the *large groups* or *distinct areas* to which we now draw attention. By means of the ether freezing microtome³ we have been enabled to examine in rapid succession a great

¹ Betz gives as the size of these "giant pyramidal cells" $40\ \mu$ to $120\ \mu$ long, by $50\ \mu$ to $60\ \mu$ broad.

² This estimate exactly agrees with that of Betz.

³ Vide *Journal of Anat. and Phys.*, April, 1877, and *Mo. Micros. Journal*.

number of sections from eight human brains in the fresh state, slicing the convolutions from end to end and examining the sections seriatim, and with the following results. The broad upper extremity of the ascending frontal convolution limited above by the longitudinal fissure, and below by the lower line of origin of the first frontal, was found to present two large groupings of these cells. (*See diagrams in the original article, loc. cit.*) The upper group corresponds to areas 2 and 4 in Ferrier's drawings;¹ the lower group, taking a position near the first frontal, corresponds closely to another motor area (No. 5 of Ferrier). In the sinuous portion of the ascending frontal, intervening between the origin of the upper and middle frontal gyri, there are two notable areas, the upper occupying the parietal aspect of the upper two-thirds of this region, the lower extending beyond the summit of the convolution towards the middle frontal. These two separate areas occupy approximately the circles 6 and 7 in Ferrier's figures.² Another very extensive group of cells occupy the posterior extremities of the two upper frontals.

To recapitulate, we have presented to us a series of distinct groupings of these great cells, arranged chiefly along the *parietal aspect* of the ascending frontal convolution, interrupted by two groups which occupy the *frontal aspect* at the origin of the superior and middle frontals, and which at these points run into an extensive area, disposed over the posterior third of the two latter convolutions. The cells are largest in those groups found at the upper end of the ascending frontal, and diminish in size towards the lower extremity of this convolution, as shewn by the following table :

	Average Size of Ganglion Cells.	Largest Cell.
Left Ascending Frontal (upper extremity) ..	$60\mu \times 25\mu$	$90\mu \times 45\mu$
Upper Frontal (area at posterior end) ..	$45\mu \times 20\mu$	$69\mu \times 27\mu$
Left Ascending Frontal (lower extremity) ..	$35\mu \times 17\mu$	$41\mu \times 18\mu$

¹ 'The Functions of the Brain,' by Dr. Ferrier. Figs. 63 and 65.

² Op. cit. Figs. 63 and 65.

Thus, throughout the region examined, these cells form an *interrupted series*, differing essentially from the continuous layers above them; and the groups thus formed are distributed over certain areas, closely corresponding to several of the motor centres of Ferrier. Each group is subdivided into numerous secondary clusters of from two to five cells—the “nests” of Betz. The all-important fact to bear in mind with regard to these elements is their *interrupted distribution*, a feature which is still maintained in districts where their diminution in size no longer warrants our calling them “Giant cells.”

In the lower third of the ascending frontal, from the origin of the middle to the inferior frontal gyrus, we recognise features approaching those presented by the ascending parietal convolution. No distinct areas of the ganglionic cells were observed, but these elements were more or less equally diffused in “nests” of small cells ($35\mu \times 17\mu$ to $41\mu \times 18\mu$) over the whole aspect of its fourth layer. I shall now proceed to enumerate the various points of interest afforded by my subsequent inquiries.

Regions Posterior to the Fissure of Rolando.

No *abrupt* passage from one form of cortical lamination to that of another is ever seen in the convolutions of the vault. Changes in type are gradually assumed, and no distinct boundary exists to indicate an exact line of demarcation. The structure peculiar to one region gradually fades and blends with arrangements which foreshadow the architecture of adjacent realms, and thus we obtain *transition regions*. The ascending parietal is such a transition region, where features characteristic of the frontal lobe are blended with those exhibiting a tendency to assume the laminar arrangements of convolutions posterior to it. By what arrangement of elements is this duplex character produced? In what respects does this region resemble the ordinary five-laminated type, and how does it diverge from the same? To reply to these questions, it is necessary to observe that the changes from the five-laminated type to that now about to be considered depend almost entirely upon alterations in the elements of the third and fourth layers. It is where these two layers approximate



Large Pyramidal Cells
3rd Layer

Small Pyramidal Cells
2nd Series

Ganglionic Layer

Spindle Cells

Bevan Lewis.

Section through Angular Gyrus. - Human Brain
Illustrative of Lamination typical of Sensory Areas
As seen in Most Cortical Regions

x 145 diam.

that we observe those changes predominate which issue in a fresh grouping of constituent elements. In the fourth layer we still find in certain situations the large-ganglionic cells so characteristic of the anterior half of the motor area. They are, however, very limited in number, and restricted within narrow bounds. They appear in sparse nests along the anterior aspect of the ascending parietal convolution, deep down in the fissure of Rolando, and are direct continuations of the groups found in adjacent portions of the ascending frontal. Far more numerous, and largest in size at the upper extremity of the gyrus, they become more thinly scattered below, and diminish in size, as do those in the ascending frontal convolution in its lower half. Throughout by far the larger extent of this convolution these great cells are not found, the fourth layer being here occupied by representative cells of much smaller dimensions. These smaller cells, however, resemble them in every respect exclusive of size, and are frequently arranged like them in clusters or nests. In the above-mentioned features this convolution *resembles* the ascending frontal—how does it diverge from it in structure? This is accomplished by the tendency to closer aggregation of the small pyramidal cell at the lowest stratum of the third layer. A numerical increase of these elements at the lower limits of the third layer goes on gradually augmenting from before backwards, so that we shall find a distinct layer has been added to the cortex betwixt the large pyramidals of the third, and the representative cells of the ganglionic series. (Plate 1.) We thus see that whilst the ascending parietal resembles the frontal convolutions in the presence of large ganglionic cells, and the nestlike arrangement of the smaller cells of the fourth layer, it diverges from it in its tendency to the acquirement of an additional series of small pyramidal elements between this layer and the third. Reference has already been made above to these small elements and their distinction from the angular cells of Meynert. It need only be added here, that in size, configuration, and branching they are exact representatives of the small pyramidal cells of the second layer. Such are the chief characters which stamp the ascending parietal convolution as transition ground betwixt a five and six laminated cortex. I will now endeavour to give

the remaining variations observed in this convolution, by describing separately each individual layer seriatim.

Lamination of Transition Realms between Motor and Sensory Areas.

(PLATE I.)

First Layer.—The characters of this layer do not differ from what have been noted in the frontal region. The cells are identical in size, structure, and aggregation. No other layer of the cortex of the vault presents more uniformity in structural details than this the most external of its layers.

Second Layer.—The cells are pyramidal or pyriform in contour, and give off from five to seven, or even more branches. They measure $8\mu \times 6\mu$, and have an oval or spheroidal nucleus, averaging 4μ in diameter. In common with these smaller cells we also find a few larger elements, attaining dimensions of $13\mu \times 9\mu$, and possessing a nucleus of 6μ diameter. A striking character, common to all these pyramidal elements, is the relatively large size borne by their nucleus to the protoplasm of the cell, as compared with the larger nerve-cells of subjacent layers.

The depth of this layer varies at different points, but an approximate average may be taken at $\cdot 186$ of a millimeter at many portions, and especially near the summit of the gyrus the depth increases to $\cdot 279$ of a millimeter. In the second frontal convolution the depth of this layer varies from $\cdot 139$ to $\cdot 186$ of a millimeter. It is a matter of difficulty to estimate with great exactitude the number and aggregation of these cells, but they are decidedly *more closely crowded* than in the ascending frontal convolution.

Third Layer.—The average depth of this layer is less than the corresponding formation in the frontal region, but less than in convolutions posterior to it. The greatest depth is attained near the upper extremity of the convolution on a level with the postero-parietal lobule. In the middle third of the gyrus this layer decreases greatly in depth, frequently measuring less than half the depth of this layer in the frontal region, but, towards the lower extremity, an increase in its depth is again observed. The average dimensions of the cells in the

upper half of the third layer is $15\mu \times 11\mu$, the nucleus measuring 7μ in diameter. These cells gradually increased in dimension with their depth, so that in the lowest stratum they range from $32\mu \times 18\mu$ to $34\mu \times 26\mu$. Reference to the table of measurements shows that these cells are decidedly larger than the corresponding cells in the ascending frontal and frontal gyri. As regards conformation and branches, the elements of both regions closely resemble each other. Comparison of sections from the ascending frontal and parietal demonstrate that these larger cells are far less numerous and more scattered in the latter than in the former region, whilst the small pyramidal cells, continuous throughout this layer, have greatly increased in numbers in the parietal region, forming here an important feature in the section.

To summarise then the distinctive features of this layer,—

1. Its depth is less than in regions anterior, and greater than in regions posterior to it.

2. Its large pyramidal cells are less numerous than in the frontal region, and are scattered in sparse groups at the lowest stratum of the layer.

3. There is a comparatively increased number of the small pyramidal cells through its whole depth which tend below to aggregate into a distinct layer between this and the ganglionic series.

Ganglionic Layer.—I have already anticipated above many of the results obtained with regard to the examination of this layer, and I shall therefore briefly summarise them as follows:—

1. The majority of the ganglionic cells form far less conspicuous objects than the corresponding series anterior to the fissure of Rolando.

2. The average dimensions attained by these cells were $37\mu \times 21\mu$, with a nucleus of 9μ in diameter.

3. Large ganglionic cells rivalling those found in the ascending frontal occur over a very limited area anteriorly, and deep in the fissure of Rolando.

4. These latter bodies average $46\mu \times 23\mu$, but frequently attain to dimensions of $66\mu \times 41\mu$ in the upper extremity of the convolution. The nucleus measures 13μ in diameter. The largest cells observed in this region measured $88\mu \times 41\mu$.

5. The average size of the ganglionic cells is invariably greater than the largest elements of the third layer, which is by no means the case in convolutions posterior to this region.

6. These great cells diminish in size (as do those in the frontal regions) towards the lower extremity of the gyrus, as exhibited by the following table:—

	Average Size of Ganglion Cell.	Largest Cells.
Left Ascending Parietal (upper extremity) ..	$66\mu \times 41\mu$	$88\mu \times 41\mu$
Do. (middle third) ..	$46\mu \times 37\mu$	$55\mu \times 32\mu$
Do. (lower third) ..	$41\mu \times 24\mu$	

Spindle Layer.—The elements constituting this formation do not differ from those of the frontal regions. Their distribution is precisely similar as they attain their greatest depth beneath the summit of the gyrus, and lie parallel with the surface of the cortex in the dip of the sulcus.

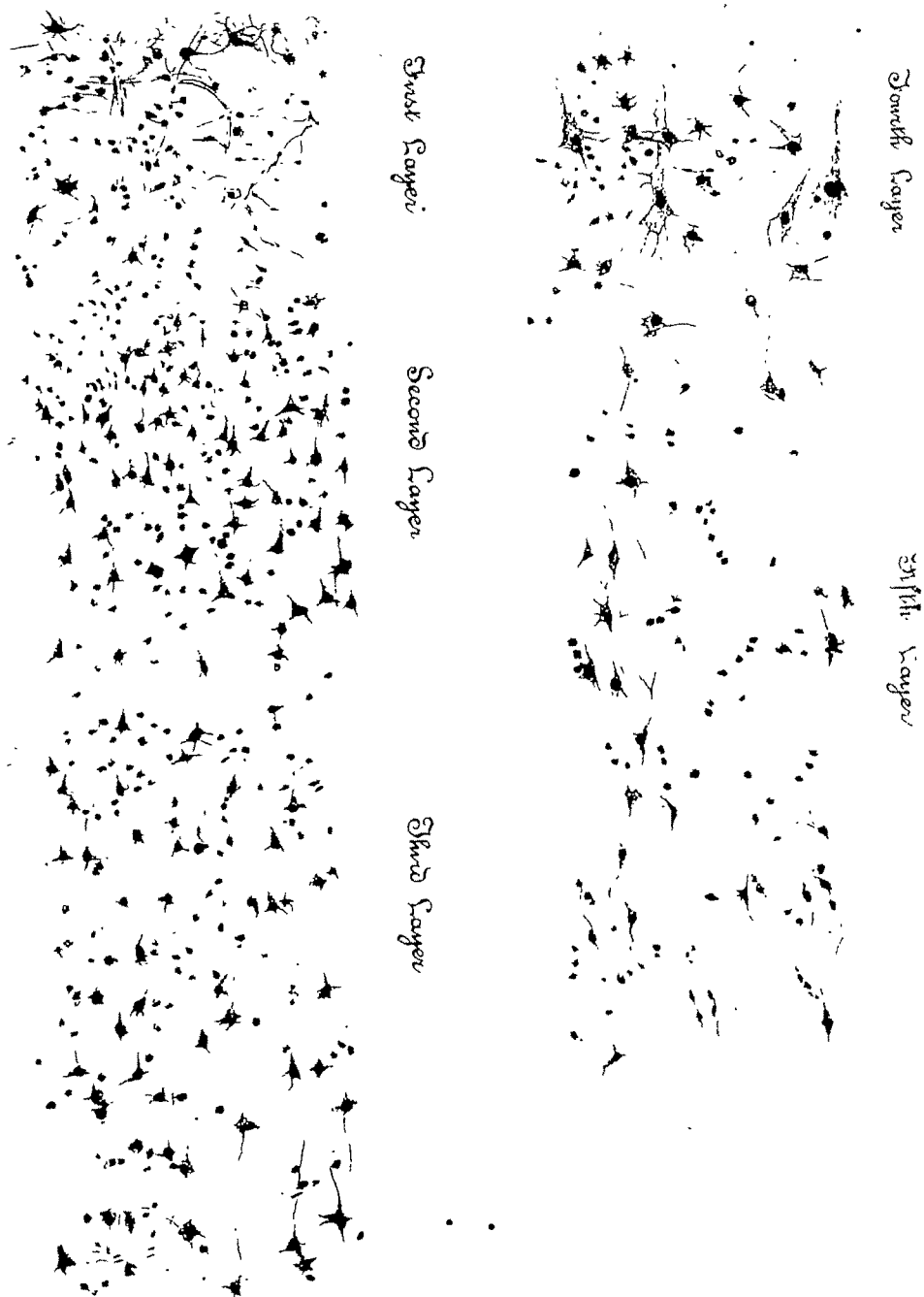
NOTE.—In this imperfect sketch of the histology of the cortex of the motor area I have been compelled to omit reference to the structure of the postero-parietal and paracentral (Betz) lobule. The latter, which is of especial interest, is a small lobule on the inner aspect of the hemisphere immediately in front of the fissure of Rolando, limited below by the Gyrus Fornicatus. I quite endorse the observations of Betz with regard to this lobule, the posterior two-thirds exhibiting in its fourth layer a dense grouping of large ganglionic cells, which in size rival those found in the ascending frontal. It is stated by Prof. Ferrier,¹ that electrical excitation of the marginal convolution in the parieto-frontal region of the monkey occasioned movements of the head and limbs, apparently similar to those obtained by stimulation of the corresponding regions on the external surface.

Lamination of the Motor Area in the Cat.

(PLATE 2.)

Sections taken through the hemispheres of a cat, in an antero-posterior direction along the vertex, demonstrate the presence of a lamination identical in most respects with what has above been described as typical of the motor area in man. This arrangement, which I have stated to be distinctly five-laminated, and characterised by a remarkable series of ganglionic cells, is seen also in the cat to be restricted within

¹ Op. cit., p. 145.



Bevan & Co

Cortical Lamination of Motor Area in the Cat
Section through pre-frontal Gyrus $\times 87$ diam.

certain definite limits, and exhibits features most highly characteristic of this formation in the convolutions bordering upon the crucial sulcus. With the object of contrasting the individual elements of this region with those of man, I shall give a brief description of each layer of the cortex; after which, I propose to summarise the points of identity and dissimilarity apparent.

First Layer.—The cells of this layer, as in man, are of two forms. The smaller measure $5\ \mu$ in diameter, and contain a large spheroidal nucleus; the larger, which measure $9\ \mu$ are frequently oval or pyriform, and exhibit a decided tendency to assume the form characteristic of those bodies known as Deiter's corpuscles, throwing off numerous prolongations which entwine upon the sheaths of the blood-vessels, and form connections with the under-surface of pia mater (Plate 2). As will be shewn when describing the cortex of the sheep, a similar condition of these elements is present, but in a still more marked degree. The depth of this layer averages $\cdot 34$ of a millimeter, being one-seventh to one-eighth the full depth of the cortex. If this is contrasted with the same layer in man, a marked distinction is observed—thus: although in frontal gyri the *absolute* depth of the first layer in man may vary from $\cdot 25$ to $\cdot 34$ of a millimeter, yet its *relative* depth to the whole thickness of the cortex is not above one-fifteenth or one-sixteenth. (*Vide* Table.)

Second Layer.—Small irregular pyramidal or ovoid cells containing a comparatively large spheroidal or occasionally oval nucleus constitute this formation. The cells measure $10\ \mu \times 6\ \mu$, the nucleus $5\ \mu$ in diameter—a measurement slightly below that of the corresponding elements in the sheep (*vide* Table of Measurements). The apex process of these cells is directed radially to the surface of the cortex, and a few extremely delicate branches arise from the basal angles. They are decidedly more irregular and stunted than in man and a bifid condition of the apex process is frequent either close to the body or at a short distance above it, reminding one of the mode in which the apex process of a Purkinje cell of the cerebellum is given off. The distinct limits of this layer, dependent for its recognition on the small size and close

approximation of elements is quite as marked as in the human brain. We find amongst these smaller cells larger bodies in scanty quantity, measuring $13\ \mu \times 10\ \mu$, with a nucleus of $9\ \mu$ diameter; these cells closely resemble those of the subjacent layer. Other bodies are also found here, measuring $9\ \mu \times 4\ \mu$, and with nuclei which average $4\ \mu$, staining *very feebly* with aniline black, thus differing from the nerve-cells whose nuclei stain of a deep black by this reagent. These elements are connective and correspond to the larger elements referred to in the first cortical layer.

Third Layer.—The average size of the nerve-cells is $16\ \mu \times 9\ \mu$; that of the nucleus $8\ \mu$. This is again below the dimensions attained in the corresponding region by the nerve-cells of the sheep. The largest cells, however, measure $23\ \mu \times 13\ \mu$ and the nucleus $9\ \mu$. Their protoplasm is extremely delicate, and numerous secondary processes as well as an apex and basal process are given off by the cell. As in man, the characteristic elements of this layer are accompanied by *small pyramidal cells* which extend through the whole depth of this formation, and at certain points aggregate into a well-defined stratum above the ganglionic series. Perivascular and connective cells are also found in this layer.

Ganglionic Layer.—The prominent features of this stratum enable us to identify it with the fourth layer of the motor area in man. A pale band containing large multipolar cells—the largest in the whole brain—succeeds directly to the large pyramidal cells of the third layer, interspersed amongst which are smaller cells of the same general characters.

I. *Form.*—The oval, or pyriform, is most general, the pyramidal is less frequent, and the fusiform is still more rarely found. The bodies of these cells are plump, contrasting in a marked degree with the compressed, elongated, and irregular bodies of these cells in the sheep. This fact may be also verified by consulting the table of measurements, where the relative breadth of these cells is far greater in the cat than in the sheep. The nucleus is invariably spheroidal, except in the fusiform cell, where it becomes oval in contour.

II. *Size.*—These ganglionic cells are smallest in the anterior limb of the sigmoid gyrus, where they average $39\ \mu \times 17\ \mu$,

the smallest not exceeding $26\mu \times 14\mu$. In the posterior limb of this gyrus, however, I obtain an average of $46\mu \times 17\mu$, a very large number even rising to $69\mu \times 27\mu$. It is at the junction of these two limbs, *i.e.*, the bend of the sigmoid gyrus round the extreme lateral end of the crucial sulcus that we find the greatest cells. In this position an average of a large number of measurements gave $83\mu \times 37\mu$, whilst occasionally a cell was met with assuming the gigantic proportions of $106\mu \times 32\mu$, with a nucleus 13μ in diameter. It will be allowed then that in point of size these elements bear no mean comparison to those of the corresponding layer in the human brain.

III. *Processes*.—The number of processes, including apex and basal process, was estimated from a large series of vertical sections of the cortex, and the average obtained was slightly over eight, but in several large cells as many as thirteen were observed. The secondary branches, as in man, radiate outwards and downwards in all directions, the cell being the centre of their area of distribution.

IV. *Distribution*.—It will be remembered that we referred to the peculiar arrangement in clusters which Betz had observed in these cells in the human cortex. These "nests" of two, three, or more cells, occasionally as many as seven, are characteristic of this region in the cat. In the upper third of the sigmoid gyrus these clusters are uniformly spread through anterior and posterior limbs of the gyrus.¹ In the middle third they chiefly occupy the summit and anterior aspect of the posterior limb where it dips into the crucial sulcus, and through the anterior limb of this gyrus they are found but scantily scattered. Still lower they appear strictly limited to that portion of the gyrus which forms the walls of the sulcus (*cruciatius*), where the clusters are not only dense and closely aggregated but the cells are of large size. The lowest portion of the sigmoid gyrus which curves round the extreme end of the sulcus exhibits large and dense clusters of these ganglionic cells, covering the region which is figured in Ferrier's drawings as No. 4 and 5. Here these cells attain to the dimensions of $83\mu \times 37\mu$.

¹ The pre-frontal and post-frontal gyri of some authors are here indicated by anterior and posterior limbs respectively.

Structure of the Cortex Cerebri in the Sheep.

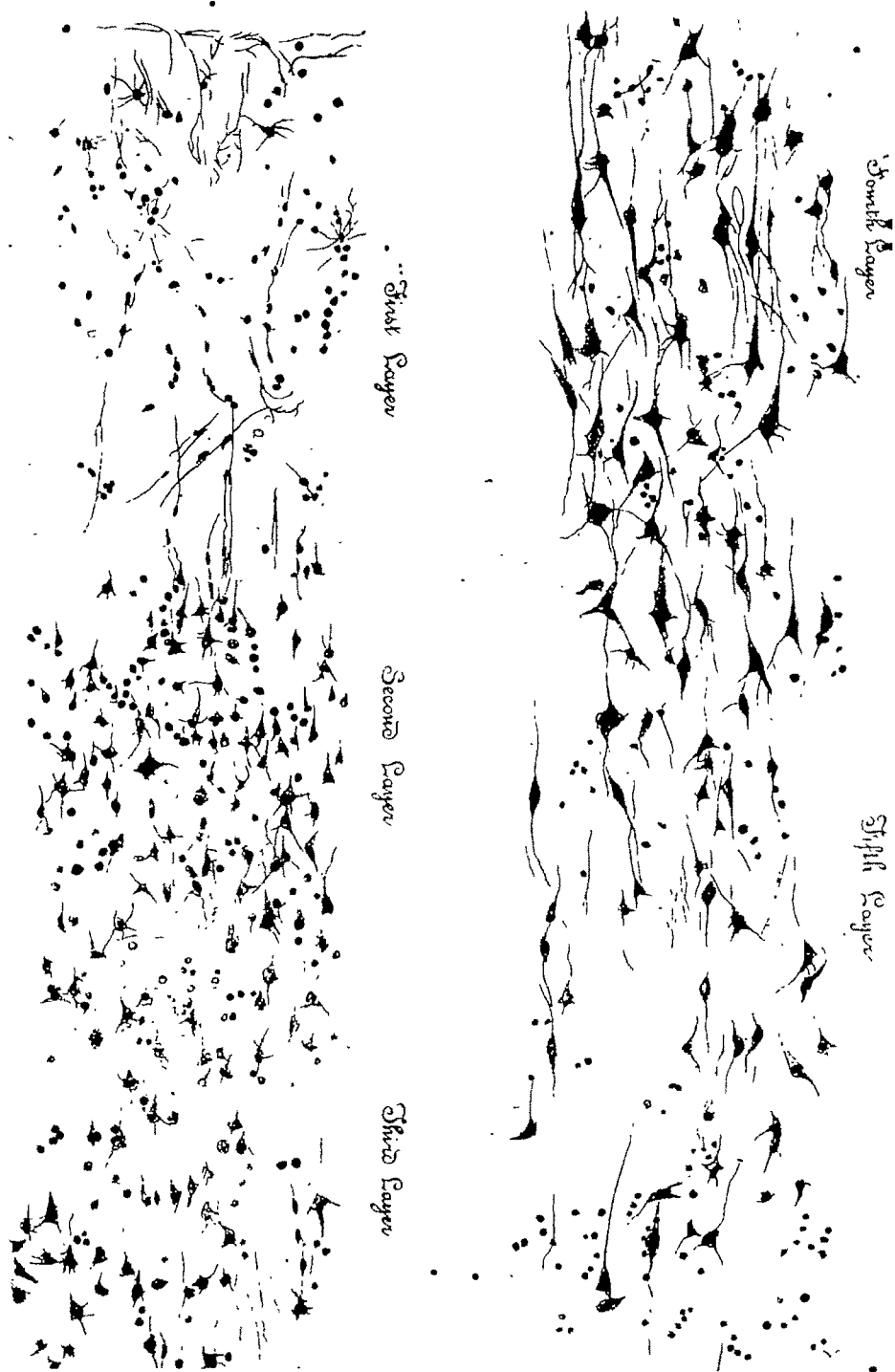
(PLATE 3.)

Lamination.—As in the cat, we find a five-laminated formation peculiar to a limited region, to which region I wish more particularly to invite attention. Its structure presents features which I believe warrant us in assuming that the region examined is from every point of view the analogue of those which are regarded as motor in the cat and higher mammalia.

First Layer.—The larger and smaller cells of this layer measure respectively 9μ and 5μ in diameter, their conformation and reactions being in every way similar to those of the cat. The neuroglia, composed as it is of connective and nervous elements, is from a preponderance of the former tissue peculiarly firm and coarse. Immediately subjacent to the pia mater a large number of bodies resembling Deiter's cells are usually seen, their processes interlacing in a most intricate plexiform arrangement, and giving rise to such firm attachment of the cortex to the pia mater that it is scarcely possibly to separate this membrane from certain portions of the cerebrum without tearing the cortex. They are found abundantly along the course of the blood-vessels, and have been stated to be seen in the corresponding layer in the cat. Dr. Major has noticed the corpuscles as of rare occurrence, also, in the first layer of the brain of the Chacma Baboon.¹ The depth of this layer averages .55 of a millimeter, and a glance at the drawings representing a section of the cortex in the cat and sheep (Plates 2 and 3) will at once render evident the great difference in the relative and absolute thickness of this layer.

Second Layer.—This layer in the sheep is a very narrow band of nerve cells, extremely irregular in contour, being small, oval, fusiform, pyramidal or angular bodies, stained very feebly by aniline, but containing a large spheroidal nucleus, which assumes a deep black hue with that reagent. The apex process is directed radially to the surface of the cortex, but very frequently assumes an irregular course. The cell itself may be bifurcate at the apex, or that process may divide into

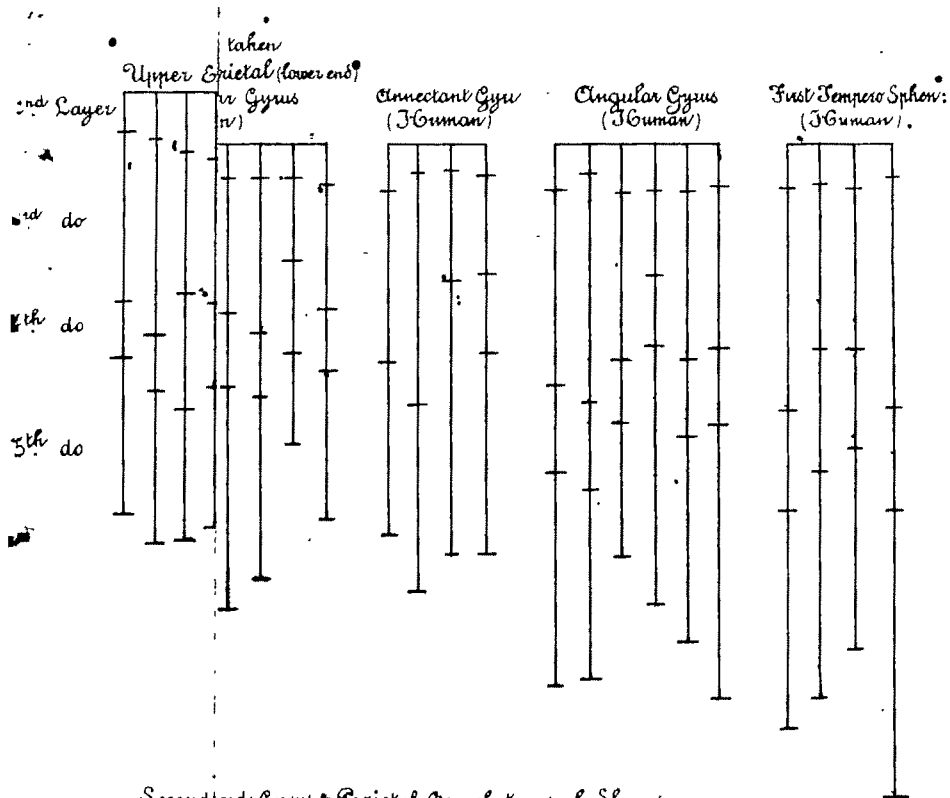
¹ 'Observations on the Brain of the Chacma Baboon.' *Journ. of Mental Science*, Jan. 1876.



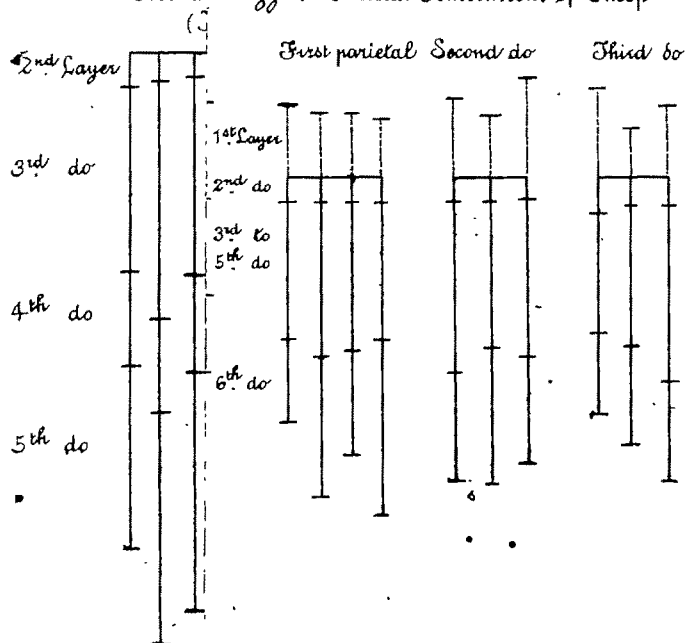
Cortical Lamination of the Motor Area in the Sheep

Brian Lewis

Section through pre-frontal Gyrus $\times 87$ diam.



Second and Third Gyri & Parietal Convolution of Sheep



two spreading arms just beyond its origin from the cell. In this layer we also find larger cells, which resemble in general characters those of the upper regions of the third layer. The small elements measure $13 \mu \times 6 \mu$, and their nucleus 6μ . They have on an average five branches.

Third Layer.—The nerve cells are very irregular in outline, but the majority assume the pyramidal form. They are frequently bifurcate, the two branches at the apex diverging widely so as to give the cell a peculiar horned appearance. The contorted form assumed by this irregular course of the apex process accounts for the frequency with which this process is cut off short in hardened preparations. In vertical sections we generally find eight branches present, inclusive of apex and basal process. The average measurement of these cells was $18 \mu \times 10 \mu$; that of their nucleus 6μ in diameter. This layer is much shallower in the posterior than in the anterior limb of the sigmoid gyrus.

Ganglionic Layer.—The cells of this formation, which in the sheep present some very remarkable features, will be considered under the heads of form, size, processes and distribution.

I. *Form.*—These elements are extremely irregular in form, and very rarely assume the plump, rounded, or oval contour seen so frequently in man, the monkey, dog, and cat. The average dimensions given for these cells below ($46 \mu \times 11 \mu$) will suffice to shew how peculiarly elongated and narrow they are in some regions. In these fusiform cells the nuclei are invariably oval. In other regions, however, especially the posterior limb of the sigmoid gyrus, these cells are larger and more of the pyramidal or oval outline.

II. *Size.*—At the upper ends of the sigmoid gyrus the average dimension of these cells is $36 \mu \times 17 \mu$ for the posterior, and $46 \mu \times 11 \mu$ for the anterior limb of the gyrus. In the former position we not unusually find numerous cells measuring $46 \mu \times 23 \mu$, approaching in outline and size those seen in the cat, whilst the largest observed measured $65 \mu \times 23 \mu$. The nucleus in the elongated cell is oval, and measures $9 \mu \times 4 \mu$; in the broader and larger cells it becomes spheroidal and 9μ diameter.

III. *Processes.*—Of a large series of these ganglion cells the

average number was slightly under eight, as seen in vertical sections: the largest number observed was twelve. This enumeration includes apex and basal process. The apex process is often peculiarly contorted and bifurcate, as in the cells of the third layer; nor does it display the rapid and delicate attenuation presented by these processes in the human brain. Its distinctness on the other hand is so marked that I have frequently traced it in the sheep, through the third and second up to the first layer, giving off few or no branches until it has entered the first layer, where it can be seen dividing and subdividing into several delicate processes.

IV. *Distribution*.—The position, size, and mode of distribution of these cells indicate their identity with those of the fourth layer in the motor area of man. They are arranged in clusters, answering to the nests of Betz, but these clusters embrace a far larger number of cells than are found in the corresponding cell clusters in man or the cat. In the posterior limb of the sigmoid gyrus we find these clusters furthest apart, their distance ranging from $140\ \mu$ to $110\ \mu$; but in the sulcus (*cruciatu*s) they are more crowded, whilst in the anterior limb of this gyrus they are separated by intervals of scarcely more than $90\ \mu$. Again, the constitution of these clusters differs widely in these two districts. Thus, in the posterior limb of the convolution, the cells are not only of smaller size but are disposed in groups of two, three, or at most, five cells, but becoming more numerous towards the crucial sulcus. In the anterior limb of the gyrus, the groups assume a peculiar and characteristic arrangement, each cluster occupying oblong areas, measuring $460\ \mu$ in depth, by $110\ \mu$ in width, and include a very great number of cells of large size, frequently as many as twenty being seen in vertical sections. These cells are closely packed within the clusters, at a distance of from $6\ \mu$ to $9\ \mu$ apart, and are peculiarly compressed and elongated in contour. The position of these clusters may be understood by supposing the sigmoid gyrus to be divided into an upper, middle, and lower third. It will then be found in the upper segment that scarcely any of these cells appear in the posterior limb, but they are present in dense clusters in that portion of the anterior limb

which forms the wall of the crucial sulcus, spreading over its summit to its anterior aspect. In the middle third a smaller grouping of these clusters is detected in the posterior segment of the convolution; but no dense clusters are met with except at the anterior aspect of the front limb of the gyrus, where just beyond its summit there is an extraordinary development of these cells.

In the lower third of this convolution, where it bends round the lateral extremity of the crucial sulcus, a very extensive grouping of these cell clusters covers the whole anterior aspect of the gyrus thickest in front, and gradually thinning off posteriorly, so that few are seen beyond the summit.

NOTE.—I have omitted a detailed description of the spindle layer in both the cat and the sheep, as the individual elements resemble in form those found in the human brain. The depth of this layer beneath the summit of the convolution is figured in the accompanying Table, where it can be readily contrasted with the corresponding formation in man.

TABLE OF MEASUREMENTS.

	MAN.		CAT. <i>Sigmoid Gyrus.</i>	SHEEP. <i>Sigmoid Gyrus.</i>
	<i>Ascending Frontal.</i>	<i>Ascending Parietal.</i>		
First Layer—				
Small Cells . .	6 μ —9 μ	6 μ —9 μ	5 μ	5 μ
Large Cells . .	13 μ	13 μ ×6 μ	9 μ	9 μ
Second Layer . .	11 μ ×6 μ	8 μ ×6 μ	10 μ ×6 μ	13 μ ×6 μ
Third Layer—				
Upper Series. .	12 μ ×8 μ	15 μ ×11 μ	16 μ ×9 μ	
Lower Series. .	41 μ ×23 μ	32 μ ×18 μ (Largest 51 μ ×32 μ)	23 μ ×13 μ	18 μ ×10 μ
Fourth Layer—				
Ganglionic Cells	71 μ ×35 μ ¹	87 μ ×21 μ	<i>Ant. Limb</i> 26 μ ×14 μ to 39 μ ×17 μ <i>Post. Limb</i> 46 μ ×17 μ to 69 μ ×27 μ <i>Base of Gyrus</i> 83 μ ×37 μ	46 μ ×11 μ 36 μ ×17 μ 46 μ ×23 μ
Largest observed	126 μ ×55 μ	88 μ ×41 μ	106 μ ×32 μ	65 μ ×23 μ

¹ Dimensions given by Betz = 40 μ — 120 μ by 50 μ — 60 μ .

MEASUREMENTS OF THE CELLS OF THE GANGLIONIC LAYER, AT
VARIOUS POINTS OF THE HUMAN CORTEX CEREBRI.

	<i>Ascending Frontal.</i>	<i>Ascending Parietal.</i>
Upper Extremity of Gyrus .	$60\mu \times 25\mu$. Largest $90\mu \times 45\mu$	$37\mu \times 21\mu$. Largest $88\mu \times 41\mu$
Opposite First Frontal. . .	$45\mu \times 20\mu$. Largest $69\mu \times 27\mu$	Largest $46\mu \times 47\mu$
Lower Extremity	$35\mu \times 17\mu$. Largest $41\mu \times 18\mu$	$24\mu \times 13\mu$. Largest $41\mu \times 25\mu$
	<i>First Temporo-Sphenoidal.</i>	<i>Angular Gyrus.</i>
Lower Extremity of Gyrus .	$23\mu \times 11\mu$	$22\mu \times 11\mu$ to $23\mu \times 13\mu$.
Upper Extremity of Gyrus .	$25\mu \times 14\mu$	

NOTE.—In the above measurements the long and short diameter of the cell, and, except where otherwise stated, the *average* dimensions, are presented. The convenience of expression of the *micromillimeter* by the sign μ , and its very general adoption by histologists, have induced me to employ it in preference to the decimal form of expression.

ON SKULL MAPPING.

BY CROCHLEY CLAPHAM, L.R.C.P.LOND., F.S.S.,

Member of the Anthropological Institute of Great Britain and Ireland.

PRESUMING that the internal configuration of the skull is a matter worth consideration, the following notes and diagrams may be found not altogether devoid of interest.

On reference to the Plate it will be seen that I have delineated the skull-line in two directions corresponding respectively to the circumferential line of the horizontal and perpendicular planes at the level of their greatest areas.

The method employed to obtain these lines is one requiring considerable care in the necessary manipulations, but beyond this presents no difficulties.

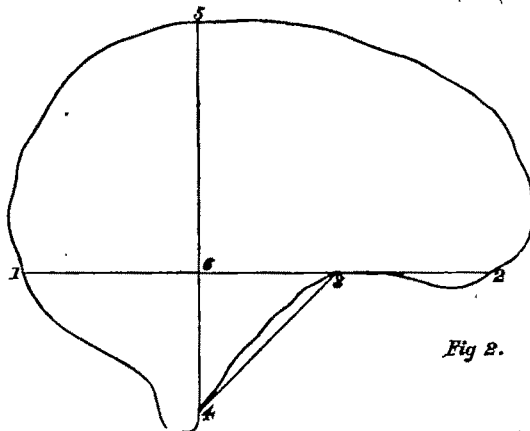
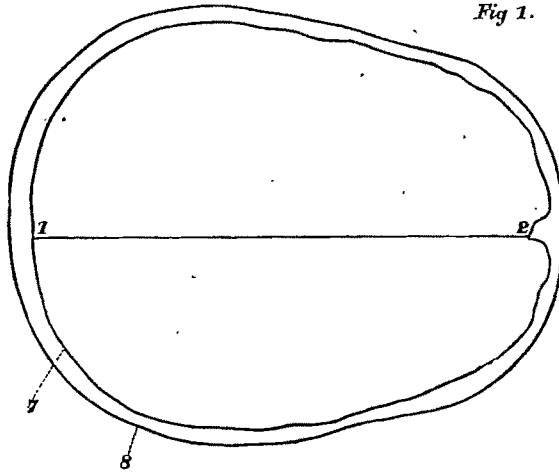
It is as follows: The calvarium having been removed in the ordinary way—care being taken that it is cut at a level of about an inch above the superciliary ridges in front and the occipital protuberance behind, and that the line is as straight as possible,¹—the brain and membranes are cleared away, and a strip of lead 17 inches long, three-quarters of an inch wide, and of the thickness of half-a-crown, is laid upon the basis cranii in the direction of its length. The anterior end of the lead must be slit for about 3 inches, so as to enclose the crista galli, and the two strips brought up to the cut margin of the skull anteriorly. The whole length of the lead included in the skull is now to be pressed close down on to the bone, and pushed into all the hollows, bent over the posterior clinoid process and into the

¹ This is best insured by the employment of an iron skull-holder, such as is used in the Post-mortem Room at St. Thomas's Hospital.

foramen magnum, then up the occipital bone to the cut margin posteriorly.

The spare lead is to be bent over forward, and its extremity placed against the tips of the anterior portion, so as to prevent springing.

The position of the torcular Herophili having been marked on



the lead with chalk, the strip may be removed bodily, placed on a sheet of paper, and the part which has been in apposition with the skull drawn round with pencil.

A perfect copy of the basis cranii in its median line will be thus obtained; and the same process being carried out with the calvarium, and adapted to the line already drawn, the complete internal antero-posterior circumference will be shown (Fig. II.).

To get the horizontal circumferential line, a ring of bone, a quarter or third of an inch thick, is carefully sawn off just below the line of incision made in removing the calvarium. If properly cut, the ring will lie flat on the table, and should be cleaned and preserved.

By placing this ring on paper, and drawing closely round it on both sides, the internal and external circumferential lines of the skull are obtained, as shown (Fig. I., 7, 8).

The lines thus taken in the two directions should be figured on the same piece of paper for purposes of comparison.

A straight line is now drawn on the perpendicular section (Fig. II., 1, 2) from the point corresponding with the torcular Herophili to the frontal bone, and just touching the posterior clinoid process (Fig. II., 3).

From 1 to 2 will constitute the base line of the skull.

If a line be now drawn at right angles to this base line, and with its lower extremity touching the anterior margin of the foramen magnum (Fig. II., 4), its upper end (Fig. II., 5) will be found to correspond, almost absolutely, with the highest point of the antero-posterior arch of the skull, and to cut the horizontal circumferential line at its point of greatest width. This line (Fig. II., 4 to 5) will be spoken of as the *line of intelligence*, and the point at which it cuts the base line (1 to 2) determines the relative size of the anterior and posterior portions of the brain, and bears, I have reason to believe, a relation to the degree of intelligence of the individual.

The space below the base line is occupied by the cerebellar and ganglionic portions of the brain.

Taking the posterior clinoid process as a fixed point, the line joining it with the anterior margin of the foramen magnum, and which corresponds pretty nearly with the basilar process of the occipital bone, will be *more* or *less* inclined as the *line of intelligence* is moved backwards or forwards. In other words, the angle 4 3 2, Fig. II., will be larger or smaller.

I may premise that this angle is remarkably open in some

of the lower forms of idiocy, almost indeed approaching the ourang-outang where it is 139° . The average of 20 insane males gave 129° , and of 12 insane females, 130° for this angle.

The only skull of a sane person which I have examined on this point gave 120° , but whether the sane average is as small as this I am unable at present to say.

Of course the above plan of delineating the interior of the skull is only applicable *post mortem*, but with the exception of the posterior clinoid process all the points used may be determined during life; and should it ever be possible to fix the position of the clinoid in the living state, I will undertake to draw a practically accurate diagram of the basis cranii and vault, as shown in the Plate, from external inspection alone.

I submit the present paper in the hope of inducing asylum medical officers and others having like opportunities, to keep diagrams of the internal skull-figure in all cases on which post-mortems are made.

I shall have some further remarks to make in a future paper on the results of my own observations upon a number of insane crania examined after the above method.

Critical Digests and Notices of Books.

Duret on Cerebral Traumatism. H. DURET. 'Etudes Expérimentales sur les Traumatismes Cérébraux,' Thèse pour le Doctorat en Médecine. 4to, pp. 337. 19 Plates and Chromolithographs. Versailles, 1878.

M. DURET, already well-known by his researches in cerebral physiology, has in this elaborate work, full of careful and laborious experiments, thrown quite a flood of light on many obscure points in cerebral pathology, and placed on a firm basis of fact much that has hitherto rested on mere speculation.

This is the first part of a work which M. Duret intends to carry out into its practical application, and deals with the mechanism and effects of cerebro-spinal shock, the effects of increase in the intracranial pressure; and the special rôle of the nerves of the dura mater, of the meningeal vessels, and of the several encephalic centres in traumatic lesions of the brain.

The main points which our author establishes in regard to the mechanism of shock are, that the cranium is a cavity with elastic walls, and filled with contents which are practically incompressible. Hence a sudden impact at any part of the cranial wall is transmitted to all parts of the interior, mainly through the cerebro-spinal fluid. At the point of impact a circle, or *cône de dépression*, is formed, to which there corresponds a *cône de soulèvement*, chiefly in the line of the thrust, and hence, if resistance is met with, the phenomenon of what is usually termed *contrecoup*, occurs, and not, as is commonly supposed, by actual concussion of the cerebral mass against the cranium.

If, however, the line of thrust coincides, more or less, with

the ventricular axis, the effect is felt chiefly at the base, more particularly in the fourth ventricle and restiform tracts, where lacerations and hæmorrhages result; or even down the whole spinal canal.

The lesions produced almost exclusively occupy the regions where the cerebro-spinal fluid circulates. These lesions are of various degrees, interstitial or superficial, and are carefully described, and beautifully figured in the chromo-lithographic illustrations which accompany the work.

The physiological effects are various, and experimental evidence is given in support of the following statements:—

At the moment of impact, an excess of tension occurs in the lymphatic sheaths which surround the cerebral blood-vessels, and, in consequence, there is a momentary anæmia throughout the whole encephalic vascular system.

This anæmia is augmented and maintained by reflex vascular constriction, of which the starting-point is irritation of the restiform tracts, and the sensory parts of the mesencephale.

To this general vascular constriction there succeeds an equally extensive vascular dilatation, which, by interfering with nutritive interchange, paralyses the nerve centres. Occasionally the vaso-motor paralysis continues until inflammatory reaction sets in, and the nervous disorders continue till death, if this is the end of the scene.

In a clinical point of view the symptoms of cerebral shock are to be differentiated into bulbar and medullary.

Their intensity and duration vary with the violence of the shock, and the point at which the primary impact occurs.

In *slight* shock the phenomena are transitory, lasting only a few moments. In *grave* shock the duration may be from several minutes to several hours. The phenomena in each case may be divided into two periods.

The first period comprises two phases: (*a*) the spasmodic or tetanic phase; (*b*) the paralytic phase.

(*a*.) Spasmodic or tetanic phase. This is characterised by vascular constriction, and general anæmia of the nerve centres. The *cerebral* functions are suddenly annihilated, there is loss of intelligence, voluntary motion, and sensory perception.

The *bulbar* functions suffer more or less. There is always cardiac and respiratory syncope, more or less prolonged, and a tetanic state caused by irritation of the sensory tracts of the mesencephale, and particularly of the restiform tracts. This is an *exaltation* by mechanical or traumatic irritation of the reflecto-motor fibres. At this period the internal temperature rises, the pulse is bounding, the heart contracts with force, and the respiration, suspended for an instant, becomes laborious, in consequence of the spasm of the respiratory muscles. This phase does not last more than a few seconds, or minutes at the outside.

(b.) Paralytic phase. According to the degree, the *cerebral* disorders are somnolence, sopor, coma, loss of voluntary motion, and sensation, more or less marked.

The *bulbar* symptoms are, secondary acceleration of the respiration; on which, if the lesion is grave, there follows a retardation, often of a very marked character. The pulse is slow, but not full, for the heart contracts softly, and owing to the general vascular dilatation there is scarcely any resistance. The internal temperature is lowered; for the blood, which at the moment of spasm accumulated in the viscera, now returns towards the periphery. The *medullary* symptoms are complete muscular prostration, loss of muscular and vascular tone throughout the whole body.

Second Period.—This is the period of congestive and inflammatory reaction. Most frequently it is dependent on the presence of localised or diffuse lesions, such as hæmorrhagic foci, rupture of the vessels or of the nerve tissue, rupture of the capillaries in the lymphatic granules of Robin, punctiform hæmorrhages scattered throughout the nerve centres. The coma continues for the reasons indicated, or is succeeded by somnolence or sopor; sensation is obtuse, and movement is automatic, or carried out only under the influence of powerful stimulation. The *bulbar* symptoms consist in febrile pulse and respiration, and elevation of the temperature. The *medullary* functions are often exalted.

In shock *foudroyant*, death results from sudden anæmia of the bulb, either in consequence of sudden rise in the internal pressure of the cerebro-spinal fluid, or in consequence of the

violent reflex vascular contraction. In this case, the cardiac and respiratory syncope, which are transitory in the slighter forms, prove fatal.

The point of application of the violence greatly influences the phenomena which ensue. In *frontal* concussion the effect is chiefly basilar, in the pons and bulb, and occasionally in the medulla. In *lateral* concussion the reaction is chiefly in the opposite cerebral hemisphere, and in this particular case, the symptomatology warrants a special name—*choc hémisphérique*. Though there is always an effect on the bulb, which explains the momentary arrest of the cerebral circulation and cerebro-bulbar symptoms, it is not uncommon to observe unilateral disorders, such as unilateral spasm, propulsion or movement *de manège*. Later on, if grave lesions exist, hemiplegia or hemianæsthesia may occur, on the same side as the violence, owing to the lesions occurring by *contre-coup* in the opposite hemisphere. When the concussion is *occipital*, the influence is felt in the frontal lobes, in the posterior parts of the hemispheres, and in the bulb at the same time.

In concussions of the *nagus* the bulb may be affected by return cerebro-spinal flux. Each variety of concussion may cause special lesions corresponding to the region to which violence is applied.

When localised lesions exist, their symptoms are manifested by localised affections, which can be distinguished from the general phenomena of concussion. These affections consist in exaltation or paralysis of function, in accordance with the kind of lesion. Lesions of the cortical motor centres, of the peduncular expansion, of the bulb or medulla, indicate their presence by localised spasms (*secousses*) or paralysis, in the muscles presided over by the centres which are injured. In the case of cortical lesions, the spasms may become generalised under the form of epileptic attacks, but they always commence with the centre chiefly affected by lesion.

Lesions of the sensory parts, such as of the nerves of the dura mater, posterior part of the internal capsule and of the cerebral peduncle, restiform bodies, sensory nerves and posterior columns of the bulb and medulla, manifest themselves in

hyperæsthesia, anæsthesia, and in reflex motor and vaso-motor spasms.

The phenomena of *apoplectic* shock, and shock of concussion are essentially similar in causation. As regards *embolic* shock the causation is different, as there is here no sudden access of pressure; causing displacement of the cerebro-spinal fluid, and thereby affection of the bulb and restiform tracts. In consequence of the sudden closure of a vessel by an embolus, there is a temporary vacuum at the part, which causes an afflux of blood and cerebro-spinal fluid from the other regions of the encephalon. Hence there is a sudden *decompression* of the blood-vessels, the result of which is rupture of capillaries, or momentary loss of function of the various encephalic centres.

In the second chapter M. Duret, besides giving an analysis of former researches on the mechanism of Cerebral Compression, describes numerous experiments, in which he produced compression either by injection of measured quantities of liquid between the dura mater and cranium, or into the arachnoid space; or by the injection of coagulable liquid, the volume of which could be measured, or by pressure on the surface of the brain with cushions of wadding, sponge, &c.

These various experiments lead M. Duret to very definite conclusions respecting the mechanism and symptomatology of cerebral compression, of which the following is a résumé.

A foreign body introduced within the cranial cavity acts not only locally on the subjacent parts, but also, if the diminution of the cranial cavity is sufficient, on the nerve centres generally. There are, therefore, two orders of symptoms, viz. local and myelencephalic, or cerebro-bulbo-medullary.

(1.) *General Symptoms*.—The physical conditions requisite for its production, are a certain increase in the intra-cranial pressure, or a sufficient diminution of the intra-cranial space. As to the amount of pressure necessary, M. Duret arrives at conclusions similar to those of Pagenstecher. It varies from 8 to 15 cm. of mercury in the milder, to from 20 to 23 cm. in the gravest form. When the pressure exceeds the arterial tension, death occurs in a few minutes.

This, on the average, requires 20 to 25 cm. of mercury.

A reduction of the capacity of the intra-cranial cavity by 7 to 8 per cent., by injection between the dura mater and the cranium; in general causes manifest symptoms; but when the injection is made into the arachnoid space 8 to 9 per cent. diminution is necessary, and death does not result till a reduction of 18 per cent. has taken place. This is due to the fact that the wax moulds itself over the whole surface, instead of acting with concentrated force.

The pressure exercised at any one point of the hemisphere is transmitted by the cerebro-spinal fluid to the whole nerve centres, and in particular to the perivascular lymphatic sheaths. In consequence of this the circulation in the nerve centres is disturbed, and in direct proportion to the degree of pressure, or diminution of the cranial space.

1. With slight pressure, the intra-cerebral circulation is not markedly modified: the absorption of some of the cerebro-spinal fluid, the extensibility of the vertebral ligaments, and of the venous sinuses allows of room being made. There are no general nervous disturbances.

2. With medium pressure, the compressed vessels admit of less blood into the nerve centres, and there is therefore ischæmia more or less pronounced of these important parts. Hence result *cerebral* disturbances, viz. somnolence, fatigue, or muscular prostration, and obtusion or loss of sensibility; *bulbar* disturbances, viz. slow pulse, laboured respiration, and lowering of the temperature; and *medullary* disturbances, viz. diminution of reflex excitability, loss of vascular and muscular tone.

3. With a high degree of pressure, the circulation in the nerve centres is almost completely stopped. Hence ensue coma or sleep, from cerebral disorder; excessively slow pulse and laborious or stertorous respiration, with progressive and considerable fall of temperature, from affection of the bulb; and lastly, complete suppression of the medullary functions shown in abolition of reflex excitability, and of vascular and muscular tone.

4. When the pressure exceeds the arterial tension, there is absolute arrest of the circulation and death.

II. *Local Symptoms*.—These are the direct result of the com-

pression of the parts subjacent to the point where the pressure is excited. On the convexity of the hemispheres, the action may be limited to the grey matter or the medullary fibres, or may extend to the peduncular expansion, cerebral peduncles, or even to the bulb, according to the degree of pressure.

1. If the cortex only is affected, phenomena of exaltation or paralysis are observed, according to the degree of pressure. In particular, pressure on the motor area causes localised spasms or monoplegiæ.

2. If the whole hemisphere is compressed towards the base of the cranium, hemiplegia results, if the pressure is anterior; and hemianæsthesia, if the pressure is exerted posteriorly.

3. Lastly, if the compression flattens the bulb and the basilar artery, bulbar troubles become predominant. In this case death rapidly ensues if the pressure persists, by arrest of the heart and respiration.

The next chapter deals with the dura mater, and its relation to cerebral lesions. This we have given in full, with the exception of experimental details, at p. 29. The facts which M. Duret has there brought forward are of exceeding importance, and many of them I can corroborate from my own observations. Many of the deductions which M. Duret draws from these facts are, I think, fully justified; but I am inclined to think that he places on the reflecto-motor influence of sensory irritation more than it will legitimately bear. While irritation of the nerves of the dura mater affords a clear explanation of the well-known fact that convulsions frequently occur on the same side as cerebral lesion and paralysis on the opposite, and similar phenomena, it does not seem to me that reflex irritation affords a satisfactory explanation of the late rigidity in cases of hemiplegia. This rigidity is constantly confined to the most paralysed parts; and I have difficulty in conceiving how irritation of sensory regions sufficient to keep up a localised permanent contracture (a fact of itself of very unusual occurrence) could exist without also causing acute pain and other sensory disturbances, which are by no means necessarily met with in this condition. M. Duret now thinks with M. Pitres, that the tetanic pleurosthotonus which results from electrical irritation of the caudate nucleus is really due to conduction to,

and irritation of the sensory part of the internal capsule or of the restiform bodies. This I by no means admit; and would ask M. Duret and M. Pitres, if such were the case, why irritation of the optic thalamus, which is situated nearer these sensory regions, has no such effect.

I think M. Duret is inclined to be too exclusive; and does not take into account the fact that the same phenomenon need not always have the same mode of causation. Though reflex contracture is a very important form of contracture, it does not follow that contracture is always of reflex origin.

Two short chapters follow: the one on the rôle of the meningeal vessels in cerebral traumatism, and the other on the effects of lesions of special regions. Though these contain many interesting details, they have less of novelty than the preceding; and, as our analysis has already extended to such limits, we must take leave for the present of this highly-important and valuable memoir.

D. FERRIER.

Darwinism tested by Language. By FREDERICK BATEMAN, M.D. With a Preface by EDWARD MEYRICK GOULBURN, D.D., Dean of Norwich. 8vo. Rivingtons. London.

SCIENCE, under the patronage of the Church, by an author whose personal character surely did not need the testimonial of the Dean of Norwich Cathedral, who is good enough to publish his opinion that a Fellow of the Royal College of Physicians "*is a Christian in something more than in name!*" It is possible, however, the testimonial is not altogether superfluous; for, if a stranger were to apply to Dr. Bateman's Christianity the test which he applies to Darwinism by taking this book for analysis on the question of "*CHRISTIANITY TESTED BY LANGUAGE*," the result would, perhaps, be as adverse and as misleading. Here are a few fragments of language to test with:—"Yes, Mr. Darwin, looking back through the dim vistas of untold ages, traverses the corridors of time, and, plunging into a bygone eternity, from the dark recesses and chasms of which, lighted up only by the beams from his

own distorted imagination, he drags into existence this monster of his own creation—this ape-like Man.”—p. 12.

Would it not have been more in accordance with Christian precept if the writer of this sentence in Cambyse’s vein had thought of the beam which might possibly exist in his own eye, rather than of the beams in the distorted imagination of one whom other men speak of, whether they agree with him or not, with reverential regard? In reference to a paper the author himself quotes from Draper, which is infinitely less worthy of the rebuke, he remarks, “I need scarcely add that the cause of truth is not likely to be advanced by such rhetorical farrago, or rather, I should say, by such coarse and vulgar abuse.”—p. 194. Again, the author says, “Mr. Darwin tackles this difficulty in the following specious terms.”—p. 17. “And so, forsooth, it is upon evidence like this, that we are asked to forego the cherished traditions of our forefathers, and to substitute the audacious theories of yesterday.”

All this about Darwin himself, whose disciples fare almost worse, for of them our author writes: “I must enter my protest against the extremely illiberal attitude assumed by some of the Evolutionist writers—an attitude which savours of sharp and clever diplomacy, rather than of fair and honourable discussion.” “Their writings being stamped with the most fulsome eulogy of each other, and with gross abuse of their opponents, together with unseemly discourtesy towards all of those who venture to differ from them,” &c.

We do not know what amount of vituperation is permissible in polemics, but the above, and similar language does seem rather strong for a Christian gentleman to use in a scientific argument. The sufficient explanation, however, would be that Dr. Bateman’s book is polemical and not scientific.

The object of the author’s publication may perhaps be given more succinctly in the words of his ecclesiastical introducer: “He aims at illustrating the truth in the grand old book that God made man in His own image; in the image of God created He him, and with this view he shows that [just as in the precinct of the Divine nature the Word, or Second Person, represents the Father to the creatures, so] the word as man’s distinguishing characteristic represents him, is the great

medium whereby he throws into other minds the thoughts conveyed in his own."—*Preface*.

The author himself writes that, "Believing my published researches furnish a powerful and original argument against the doctrine of evolution," "I hope that I can furnish an additional and original argument against this dangerous heresy, by showing that the possession of articulate language establishes a difference between men and animals—a difference not of degree only, but of kind. In order to establish my position, I shall have to consider three propositions:—

"I. That Articulate Speech is a *distinctive* attribute of man, and that the ape and the lower animals do not possess a trace of it.

"II. That Articulate Speech is a universal attribute of man—that all races have a language, or the capacity of acquiring it.

"III. The Immateriality of the Faculty of Speech."

With regard to the first proposition, we may remark that if by articulate speech the author means speech composed of jointed sounds, or even merely distinct speech, there is certainly no native of Northumberland who can rival in its use a well-taught parrot.

But does articulate speech make a man? If so, what about educated deaf-mutes? What about that monkey of whom Locke writes in his chapter on Language? "For were there a monkey" [*homme manqué*], "or any other creature to be found, that had the use of reason, to such a degree, as to be able to understand general signs, and to deduce consequences about general ideas, he would no doubt be subject to law, and in that sense, *be a man*, how much soever he differed in shape from others of that name."

On the second proposition we may remark that the "capacity of acquiring" is something very different from the possession of articulate language. The third proposition, however, leaves us so agape and aghast with surprise, that it is not until we have read on almost to the end that we have been able to discover anything like a possible answer to the conundrum. The author, abominating heresy, declares that an "antagonism to religion is patent in the writings of many of the evolutionist school, who ransack the storehouse of

natural science for weapons against Holy Writ. They unfurl the flag and blow the trumpet of defiance; their motto being *Ecclesia delenda est*." Now one of the blazing heresies against the orthodoxy of the Church which the author thinks he is so strenuously propping is supposed to be materialism, and to be a materialist would to some venerable deans be worse than to be "a Christian merely in name." The orthodoxy, however, of Dr. Bateman is that "In later times the brain has been universally considered to be the organ of thought and intelligence," and that "this very indefinite and unnecessary word *materialism* is used as a kind of psychological scarecrow to frighten all those who are endeavouring to trace the connection between matter and mind." But, in addition to these fundamental views he is actually a disciple of the great Gall himself, of whose great work on the "Functions of the Brain," he says that "I look upon it as an imperishable monument to the genius and industry of one of the greatest philosophers of the present age."

In this difficult position, therefore, it is no great wonder that our author should be led to discover for himself a new element of Immateriality, if one may speak of elements in such connection, and behold it in articulate speech; so that *Vox et præterea nihil* has henceforth to be inverted in sense, seeing that it is just *vox* which is *nihil*, the sense of which is as undiscoverable as the source of the *nihil*. "Does the loss of it, immaterial articulate speech," asks our author, "necessarily imply organic lesion of structure—*material damages*? If it were so, how can we account for the cases recorded in which the restoration of the power of speech was due to the effect of a severe mental shock? We are all familiar with the story in Herodotus of the son of Croesus, who had never been known to speak, but who at the siege of Sardis, being overcome with astonishment and terror at seeing the king his father in danger of being killed by a Persian soldier, exclaimed aloud, *Ἀνθρώπε, μὴ κτείνῃς Κροῖσον* ('O man! do not kill Croesus'). This was the first time he had ever articulated, but he retained the faculty of speech from this even as long as he lived." Our author gives full credence to Herodotus, and supports it by other similar cases, one observed by himself; but in this case

he fails to notice the all essential distinction that the man who suddenly spoke had previously suddenly become speechless, and therefore had not found his voice for the first time. Guggenbühl recorded a really similar instance, in which one of his speechless cretins suddenly cried out, "Die Sönne, die Sönne," and always continued to speak afterwards. Unfortunately for the Swiss philanthropist a wicked and perverse generation did not believe him, the marvel only leading men to enquire as to his trustworthiness in other matters; and the result being that in no long time the sun set upon the cretin school of the Abendburg for ever. But the final proofs of the Immateriality of Speech and Broca's discomfiture are derived from the case recorded by Velpeau, in which a man in excellent health with the exception of prostatic disorder, "very lively, cheerful and full of repartee, and evidently in the possession of all his faculties, one remarkable symptom being his intolerable loquacity, died suddenly, and a careful autopsy was made. On opening the cranium *a cancerous tumour was found which had taken the place of the two anterior lobes!*" On this record our author remarks, "Here then was a man who, up to the time of his death, presented no symptoms whatever of cerebral disease; who far from having any lesion of the faculty of speech, was *unusually loquacious*; and who, for a long period prior to his decease, must have had *a most grave disease of the brain, which had destroyed a great part of the anterior lobes.*"

Please, however, to remark the difference between the two sentences which we have put in italics. And these are the kinds of facts which are expected to confute Broca and Ferrier; this is the kind of argument which, under the ægis of the Dean of Norwich, is hurled against Darwin. Verily, "the missing link" himself, that "unusually wise ape-like animal" against whom Dr. Bateman manifests such withering hate and scorn, could not have been expected to use worse arguments, if he argued at all, which, perhaps, he did not, being in several respects, perhaps, more rational in his mode of life than some of his human descendants. It is quite certain, for instance, that, unlike the miserable man whose suicide is recorded by

Dr. Bateman, he did not destroy himself in disgust at his ape-like ancestry.

But it might be that this lunatic had read the 119th Lyric of 'In Memoriam,' in which the Poet Laureate expresses his thought that "we are not wholly brain":—

"Not only cunning casts in clay :
Let Science prove we are, and then
What matters Science unto men,
At least to me? *I would not stay.*

"Let him, the wiser man who springs
Hereafter, up from childhood shape
His actions *like the greater ape,*
But I was born to other things."

Is it possible the self-destroyer, whose crime our author records, had carried into action the wild suggestion he had read in these lines?

To us it would seem a curious kind of religion which should lead a man, in stomachful pride, to fierce rebellion against the manner in which God has created us, whether His method has been that of evolution, or some other more speedy, but less intellectual one. If God is an intelligence, the great probability is that He has created man according to an intelligent method, and the only truly intelligent method which has ever been suggested is that for the probability of which Darwin has collected an amount of evidence which must be quite immeasurable, inconceivable, and incomprehensible to any mind capable of compounding the incongruous *bolus* of theology, metaphysics and science which is presented to us in this book.

JOHN CHARLES BUCKNILL.

Clinical Cases:

CASE OF CEREBRAL TUMOUR—SYMPTOMS SIMULATING HYSTERIA.

BY A. HUGHES BENNETT, M.D.,

Physician to the Hospital for Epilepsy and Paralysis, Regent's Park.

THE following case is worthy of record, not only on account of many intrinsically-interesting features connected with it, but also because during life the true nature of the disease was not ascertained. It serves to point out the difficulty of diagnosis in obscure nervous lesions, and the extreme caution that the physician should exercise in treating as a functional or emotional complaint what in reality may be serious and fatal organic disease. Such errors, more especially if no care or precaution in investigation has been neglected, often teach a useful lesson.

Miss A., a young lady aged sixteen, first consulted me on April 1st, 1876, complaining chiefly of blindness, imperfect hearing, and loss of power in her lower extremities. On interrogating her relatives it was ascertained that her father, although an able man of business, was of excitable temperament, and had been subject to several attacks of what seems to have been acute mania. Her mother died while she was an infant, and nothing definite could be ascertained concerning her health. An aunt was stated to be of unstable mind. Her sisters are all of nervous and hysterical temperament, and at least one of her brothers has shown a tendency to inherit his father's mental disposition. The patient herself had evidently been a precocious child. It is stated that in extreme youth she always exhibited unusual sharpness and intelligence, generally employed for mischievous or destructive purposes. Her step-mother, who is a remarkably sensible person, and her elder

sisters describe her as having always been a "very-naughty child" who took a special delight in annoying and playing malicious tricks on her companions and relatives. She menstruated at the age of eleven, and has continued to do so regularly until her illness. Since that period she has been unusually developed, physically and mentally, for so young a person, and she still retains her reputation for wilfulness, cunning, and bad temper, although she can make herself amiable and agreeable when she pleases. She has been constantly engaged in reading novels and literature of an exciting and amorous character, and her mind seems to have dwelt incessantly on such subjects, as evidenced by her conversation and conduct. It was also markedly apparent that she did not behave to the opposite sex with the caution and modesty customary in persons of her position in society. On several occasions she was detected in more than equivocal relations with men, and it is stated that she was at least on one occasion overheard making indecent overtures to her own brother. Although, as a rule, she affected to despise the society of her own sex, she had one or two very special friends at her different schools, and the relations between them gave rise to very grave suspicions. From a German school, where certain minor indiscretions, not of a very reputable character, were proved against some of her companions, she was expelled, and it was stated by her schoolmistress that her offence was so bad that she declined to give an explanation for her dismissal, and her parents knowing her habits did not press for a reason. Subsequently she went to a school at a fashionable watering-place near London, where her behaviour was characterised by general misconduct. At various times she had fits of laughing and crying, and the irregular movements associated with a nervous attack. In October, 1875, and while apparently in good health, she declared that she had become suddenly blind. As this occurred immediately after correction for mutinous conduct, and as she had got the reputation of being extremely cunning and wilful, the schoolmistress and others thought she was malingering. A medical man called in, stated that he could find nothing the matter with her. Some few days afterwards she completely recovered her sight. This still further seemed to indicate that her alleged complaint was either intended or imaginary. She spent her Christmas holidays at home, accompanying her family to evening parties, &c. She was then seen by a London physician, who stated that she was hysterical, and who ordered strict moral control and cold baths. On returning to school, which it seems she disliked, she again stated that she had become perfectly blind,

and in addition deaf. She continued for some weeks in this condition when her hearing became completely restored, but the blindness remained. She was attended at different times by several practitioners, who agreed that the symptoms were of an emotional or imaginary nature, and that the patient was hysterical, and they ordered appropriate treatment. About February, 1876, she stated that she very rapidly lost the power in her lower limbs, and that she could not walk. This, it was supposed, indicated her desire to avoid the daily walks which she disliked, and to have drives instead. With this also the deafness returned. In this state she continued till April 1st, when I saw her for the first time.

The condition of the patient was then as follows:—A tall, full-grown, highly-developed, healthy-looking young woman. She stated that she was quite blind in both eyes. A variety of methods were tried to test this, but without any definite results. The pupils were both widely dilated, and very sluggish in their movements. On ophthalmoscopic examination, with the exception of the vessels of both discs being very slightly congested, the appearances were normal. She also stated that she was completely deaf in the right ear and partially so in the left one, so that one had to talk loudly to be heard. I observed, however, that on some days she could hear perfectly well. Examination of the ear revealed nothing. She complained of slight weakness of the lower limbs, and that she could walk only with the greatest difficulty. On examining these they were found of good muscular development. When lying on her back, motion and sensation seemed perfect, but at times there was hyperæsthesia of the skin of the legs. When she walked she staggered and moved about awkwardly, and stated she felt as if her legs gave way under her. There was no tenderness or abnormal condition of the spine. She stated that she suffered frequently from severe headaches in the occiput, which, however, were not constant, and lasted only a few hours at a time. The memory and intellect of the patient were in no way affected. She described all her symptoms with the greatest minuteness and exactitude. She had that manner of exaggerating her ailments so common in nervous persons. She cried out if her foot was touched, but on taking her attention away from it, firm pressure could be made without causing her to wince. The pulse was 100. The extremities were cold and blue. Temperature normal. Tongue slightly furred. Bowels constipated. Appetite good. She had not menstruated since her illness commenced, otherwise all the other systems were normal. On subsequent

investigation there was abundant evidence that masturbation was practised to a very great extent.

The diagnosis being uncertain, no active treatment was adopted. General hygienic and dietetic measures were suggested till the case had been further observed. The above conditions remaining, an eminent London physician saw the case with me. He came to the conclusion that it was one of aggravated hysteria, and gave as his opinion that little was to be done except placing her under judicious moral control. A respectable and experienced nurse was engaged to look after her under my direction, the patient remaining at home. There was no special medicinal treatment, except occasionally simple domestic remedies. She in no way improved. Every now and then she had attacks lasting from one to three hours which had all the appearances of hysterical fits, involving shouting, laughing, crying, throwing herself about, striking the nurse, &c. On April 15th, her blindness remaining as before, she stated that her deafness had so increased that she could only hear with the greatest difficulty. The nurse said that at times she could hear quite well. She could now hardly walk, and could only with difficulty crawl from one room to another with assistance. On four or five occasions another physician saw her with me, and after considering her condition from every point of view he was of opinion that it was a case of hysteria. On April 25th she became restless and greatly excited, chiefly at night, and frequently alarmed the household by crying out and getting out of bed. Change of air and scene were judged advisable, so she was boarded in a private house in the suburbs of London. The excitement continued to increase till on the 28th there were wandering and delusions. She was now totally blind, deaf, and could not stand or move her limbs. She did not know anyone, and passed the contents of the rectum and bladder in bed. Her appetite failed; she complained of violent headache: her pulse was 140. Temperature could not be ascertained. On May 1st she became unconscious, and wildly delirious, raving chiefly about some faults she had committed at school, about babies and their birth, tying the umbilical cord, &c. Pulse 150. These symptoms continued till the 4th, the patient becoming gradually weaker. In the afternoon she appeared quieter; and at my visit about 5 P.M., I found her seated in an arm-chair by the fire. It was obvious she was very feeble. Shortly after this she became suddenly comatose, and in spite of every effort to support her strength with nutrients and stimulants, she gradually sank at about 2.45 A.M. next morning.

At the Autopsy, which I had the greatest difficulty in

obtaining, Dr. Robert Lee kindly assisted me. We found the body well nourished, and all the organs healthy, except the brain. On removing the calvarium, the pia mater was found deeply congested, and scattered over its surface were found five or six tubercular-looking bodies about the size of small millet seeds. The vessels on the surface of the brain were greatly engorged with blood. On removing the cerebral lobes in thin slices, a tumour was discovered in the right hemisphere. On further manipulation this mass was found to be about the size and shape of a hen's egg, of a dark grey translucent colour, and of nodulated appearance. It was of soft consistence, highly vascular, and on its surface were small extravasations of blood. It occupied the medullary substance of the middle lobe superior to the lateral ventricle, with the cavity of which it did not communicate, although it caused a marked bulging of its roof. As it was inconvenient to make careful observations and dissection in a private house, the whole brain was removed and taken away for subsequent investigation. Having to leave London the same night for some days, I left the preparation in the hands of a medical friend to preserve; but on my return I found that, owing to some mistake, the specimen had been unfortunately destroyed, so that I had no opportunity of investigating the exact relations and structure of the tumour.

Commentary.—From the commencement of her illness this patient had been looked upon and treated by her relatives and medical attendants as a wilful and cunning hysterical subject. At first sight, considering all the circumstances of the case, I confess my own impression was in accord with this idea. At the same time I reserved my opinion, and, seeing the case was a grave one, no active treatment was employed, and I had considerable difficulty in persuading her relatives that under any circumstances her condition was one of disease, and not of malingering. Subsequent observation convinced me that there was some serious organic mischief in the brain, although I did not attempt to define its exact anatomical characters. Dr. Russell Reynolds says that to confound hysteria with tumour of the brain indicates either "carelessness, or a prejudiced view of dealing with the obscure affections of women." Such was certainly not the case in the present instance, as this patient's condition was most carefully and impartially investigated from every point of view, and she had the benefit of being several times most attentively examined by one of the first authorities in Europe on nervous diseases.

The following circumstances seem to have weighed with the different medical men under whose care she had been, in

making the diagnosis of hysteria. The family history, the patient's age, whole life and character, her sentimental and romantic disposition, her precociousness both mental and physical, her abnormal sexual passions (which were known to be gratified in an illegitimate manner), and her irregular menstruation. The circumstances of her actual illness also were anomalous. The sudden attack of total blindness—she being in apparently robust health—at school while angry and sulky after correction for misdemeanour, the equally sudden recovery of sight some days afterwards, the sudden loss of sight a second time and deafness, the restoration of hearing, the loss of power in her lower limbs, the subsequent total blindness, deafness and paraplegia. The absence of severe constant headaches, of strabismus, ptosis, diplopia, of facial or lingual paralysis, of convulsions, vomiting, wasting, of abnormal ophthalmoscopic appearances, and many of those symptoms so frequently associated with tumour of the brain. Finally the dilated pupils, the hyperæsthesia of the skin; the fact that she had had attacks of laughing, crying, and throwing herself about—all occurring in a healthy young woman of good appetite and strong muscular development, and whose appearance and character were eminently suggestive of what is described as hysterical,—gave rise to the view that the case was one rather of emotional than of organic disease.

When the facts of the case are examined, it will be seen that for some years the patient had been in what is called a hysterical state, by which I apprehend is understood a condition occurring in women of the nature and morbid lesion of which we are ignorant. How far this state was owing to the presence of the tumour it is impossible to say, as it cannot be even surmised when this commenced to grow. It was not till October, 1875, that any definite symptoms of pressure manifested themselves, and we must assume that by that time the tumour had reached considerable dimensions. If the disease was of slow growth, it remains an important question how far the previous so-called hysterical symptoms were connected with its presence. If we admit any such connections, it would indicate that organic disease in the brain is capable of inducing those anomalous disorders to which are applied the terms functional and hysterical. If this be so, this case is further evidence to those who think with me that this so-called hysteria is the result of some definite nervous structural change, with the nature of which we are as yet unacquainted, and, whether due to direct alteration of tissue, or to modification in the circulatory or nutritive processes, remains yet to be demonstrated.

There are other features in this case which are somewhat unusual, and difficult of explanation. The fact that while in good physical health, and previously having had no definite symptoms, the patient becoming one day while angry suddenly blind, can, I apprehend, only be explained by assuming that the tumour had reached a certain size without producing any special effects of pressure, being situated as it was in the medullary portion of the hemisphere. While in the angry fit, the growth, which was afterwards found to be very vascular, must have become engorged with blood, or there may have been hæmorrhage from some of its vessels, hence the sudden blindness. The congestion subsiding, or the blood-clots becoming absorbed, the sight gradually returned, to be followed before long by a similar recurrence, and subsequently in addition by deafness and paraplegia, all of which fluctuated in intensity.

Paralysis of both lower extremities without any other motor nerves of the body being affected, also is difficult of explanation, and we can only assume that the tumour by pressure caused such venous congestion in the pons or other parts of the brain as to bring about this symptom. The case would also seem to support the recent views of Dr. Brown-Séquard on "Paralysis from Brain-disease."

It is unfortunate that the specimen was accidentally destroyed, as it would have been interesting to know its structure and exact relations to surrounding parts.

In conclusion, there appear to me to be at least two points of interest in this case: 1st, the anomalous symptoms of pressure caused by the tumour; and 2nd, that symptoms of what is called hysteria may co-exist with organic disease of the brain—whether independent of it or the result, being in this patient doubtful. Under any circumstances it serves to indicate what caution should be exercised in diagnosing, and more especially in treating as hysteria, any nervous affection in women which may appear indefinite or mysterious.

TWO CASES OF LEAD PALSY, WITH REMARKS ON THE DIAGNOSIS.

BY THOMAS BUZZARD, M.D.,

Physician to the National Hospital for the Paralysed and Epileptic.

ABOUT a year ago a married lady was brought to me by her medical attendant, complaining of great loss of power in the right hand and left foot, which had been gradually increasing for three or four months; and was then so confirmed that she dragged her foot, and could do nothing with her hand. She was 26 years old, healthy looking, and the mother of three children, of whom the youngest was two years of age.

On examination, the right forearm, at a point four inches below the olecranon, was found to measure $7\frac{3}{4}$ inches, as against $8\frac{1}{4}$ inches, the size of the left at the same level. The plump of the thumb, too, of the right hand appeared somewhat thin, and the interossei depressed. The hand could not be brought to a level with the forearm. Its grasp was feeble, and the patient could not perform delicate movements with the fingers. The left foot dropped when lifted off the ground. On the other hand, there was nothing wrong, so far as could be observed, with the left upper and the right lower extremity. This *bizarre* arrangement of the paralysis had suggested to more than one medical observer that the affection was of an hysterical character. The general health was described as fairly good, except that there had been occasional vomiting. The patient was not constipated, nor had she suffered from colic, and careful examination failed to show the slightest trace of any blue line in the gums. Enquiry had not succeeded in eliciting any history of exposure to lead.

When the excitability of the muscles came to be tested by electrical currents, important changes were observed. On the right side none of the muscles on the back of the forearm would respond to the highest strength of induced currents which could be borne, except two. The supinator longus con-

tracted freely to a moderate strength; and the supinator brevis, which, owing to the wasting, could be picked out by the rheophore between the short radial and common extensors, answered readily enough to the stimulus, producing brisk supination of the hand. The intrinsic muscles of the hand likewise failed to respond to Faradaism. To a voltaic current from eight cells of a Stöhrer's battery, slowly interrupted, all the muscles which had been unaffected by the induced currents contracted freely; whilst the supinators showed no response to this stimulus, which is not sufficiently strong to affect healthy muscles.

The left leg presented similar inexcitability to Faradaism, coupled with active response to weak voltaic currents in the tibialis anticus group of muscles.

In the left forearm, which presented no obvious lesion, it was found, nevertheless, that the excitability to Faradaism was below the normal in the extensor communis digitorum.

In the right leg, too, there was slight diminution of excitability to Faradaism, but in neither was there exaggeration of irritability to interrupted Voltaism. There was slight loss of electro-cutaneous sensibility in the right forearm and left leg.

The result of examination thus made it evident that the patient was suffering from lead poisoning, and a confident opinion was accordingly expressed to this effect. But the possibility of such a cause was at first strongly denied, both by the patient and her husband. It was only after persistent enquiry that the following fact was elicited. About three weeks previously, the zinc cistern supplying the patient with drinking water had been cleaned out, and three or four feet of lead-piping was found lying loose in the bottom of it, having been dropped there by a careless workman. How long it had lain there could not be ascertained, but it must certainly have been many months.

A few months later a middle-aged lady was sent to me by a medical friend on account of powerlessness of the hands. The weakness, it seemed, had commenced more than five years before, and had gradually increased so much that she had come to have great difficulty in doing anything with her hands. In the course of her long illness she had been seen by several medical men, who had pronounced her, so I was told, to be suffering from Cruveilhier's atrophy affecting the muscles of the hands. She had not had any electrical examination.

There was a helpless look about her hands, which "dropped" somewhat, and could not be kept perfectly extended. The forearms were round—somewhat plump-looking indeed—and

in contrast with them the hands appeared to be wasted more than a closer observation showed them really to be. The fingers could be moved freely enough in various directions. The patient had pains in them occasionally. There was no flattening of either forearm, but the flesh when handled felt pulpy, and wanting in firmness. Whilst the hand could not be extended against even a very slight opposition on the part of the examiner, the movement of supination was performed readily, and with good force.

Electrical examination showed the excitability to Faradaism to be very much diminished in the *extensor communis digitorum*, *extensor indicis*, and *extensores carpi radialis longior* and *brevior*; not so much, but still appreciably lessened in the *extensor carpi ulnaris*. The *supinator brevis* could not be reached—the *supinator longus* reacted to Faradaism. The intrinsic muscles of the hands reacted to Faradaism equally well on each side, and if there was any diminution of excitability in them, it was but slight. There was an indefinite history of impairment of general health, and the occurrence of occasional spasms of the bowels. An opportunity was not afforded me of examining the gums.

An opinion was given as the result of this examination that the case was one of lead poisoning. On enquiry as to exposure, it appeared that the patient had been in the habit for many years of applying to her head one of the popular "hair restorers," the active ingredient in which is known to be lead. The quantity used at a time was said to be small (which is a relative term), but its application had been constant.

A history of exposure to lead, the presence of a blue line on the gums, preceding colic, and the peculiar character of the affection, are features commonly adduced as the diagnostic signs of lead palsy. The history of exposure, however, has often to be sought out by pertinacious enquiry after the diagnosis has been formed through other sources. So again the blue line may be wanting, and there may have been no colic. It is, then, to the peculiar character of the palsy, and especially to the effects of electrical currents on the muscles, that we have usually to look for the most valuable—the only reliable evidence, indeed, of the nature of the disease. The cases described seem to me worth recording as illustrations of the value of these signs.

In both the examination by means of electrical currents gave results in accordance with Duchenne's well-known description of the characteristic signs of lead palsy. The excitability to Faradaism was absent or sensibly diminished

in all the muscles of the forearm, except the supinator longus and brevis. The fact that those muscles were not included in the paralyzing influence was shown in two ways—1st, when the patient had semipronated the hand, and then flexed the forearm on the arm, the observer tried to extend the forearm against her resistance, when the supinator longus could be felt contracting strongly; 2nd, by testing the muscles with induced currents, when it was found that they retained their normal excitability. The opportunity which I have had of observing a considerable number of cases of lead palsy has shown me that the signs noticed are those which are commonly found. Duchenne went so far, I think, as to say that he had met with no exception to the rule that the supinators were exempted, and writers have repeated his description. But the rule is not quite without exception. I have seen some well-marked instances of the supinators taking their share in the common lesion. These have been, however, comparatively very few indeed, and have always occurred in cases where the exposure has been long continued, and when, if I am not mistaken, some muscles of the arms, as well as the forearms, were involved in the atrophy. So that for all practical purposes, Duchenne's rule appears to me one to be depended upon—at least in cases which are not of very old standing indeed, or of exceptional severity.

In health, the supinator brevis cannot be directly faradised on account of its deep position. But in lead palsy it very often happens that the wasting of the extensor communis digitorum has proceeded far enough to uncover the supinator brevis sufficiently to allow a small rheophore to be applied to it. Under these circumstances the electrical diagnosis is singularly simple, and can be carried out in about the space of a square inch at the upper and back part of the forearm. If it be found (both arms being affected) that the common extensor fails to respond to Faradism whilst the short supinator close by, on a lower plane, is readily excited by it, the case may be positively set down as one of lead palsy.

The exaggerated reaction to voltaism in the first case is not at all unfrequent in cases of lead palsy of not long standing.

The crossed arrangement of the paralysis in the first patient is curious; and had the apparent exemption of one leg and one arm on opposite sides been as real as it looked, explanation of the anomaly would probably have been impossible. But the electrical examination showed that the difference was in truth one of degree only. The apparently sound limbs betrayed characteristic signs of lesion in the diminished excitability of their muscles, and it was evident that time only was required for them to share the trouble of their fellows. It is much more

common than not in cases of lead palsy for one limb to suffer more than the other. In this instance, however, the contrast was more than usually strong.

It is an interesting fact, that in the apparently sound limbs, there was diminution of electric excitability in muscles which, according to the patient's own feeling, had nothing the matter with them.

In the second case the absence of any flattening of the fore-arms—their marked roundness, indeed—was likely at first sight to cast doubt upon the probability of there being any atrophy of the extensor muscles. But although in many cases of lead palsy, especially in those of rapid and recent occurrence, there is an amount of excavation which is quite remarkable in the situation of the extensor group, yet in those of old standing one often sees that the affected limb wears a false air of nutrition. It is known that this depends upon a large interstitial development of adipose tissue separating and surrounding the wasted and degenerated muscular fibres. No doubt this had happened in the present instance, where the disease, although not very extensive, had existed more or less for some five years.

The entire absence of the blue line in the gums of the first patient is noteworthy, as it tended to obscure the diagnosis. Although the absence of this sign is not by any means unexampled, it is certainly rare in a case of lead-poisoning so marked as this was, to find no characteristic discoloration in the gum. I explain its absence here by the fact of the exceeding care which the patient had evidently taken in brushing her teeth, which were scrupulously white and perfect. As Mr. Tomes has described, it seems likely that it is to the decomposition of portions of food left about the margins and interstices of the teeth, and in the tartar often collected there, that the discoloration is due, sulphuretted hydrogen thereby formed acting upon the lead in the neighbouring tissue. It is worth remembering, as this case well shows, that the blue line is not a necessary feature of lead-poisoning in persons of cleanly habits. Probably the converse is still less to be depended upon. The presence of a very well-marked lead line is quite consistent with health. Some time ago I examined a number of men employed in lead-mining and lead-smelting in Derbyshire. They had all more or less of a blue line in the gum and their complexions were generally pale, but none had any complaint to make of their health. Lead-poisoning, indeed, is as rare amongst the men thus engaged as it is common among those who are employed in the manufacture of white and red lead.

CASES OF CEREBRAL EXCITEMENT TREATED BY MUSTARD BATHS.

BY A. R. URQUHART, M.D.

SOME thirteen years ago it occurred to Dr. Newington that the mustard bath, which he had seen employed in hydro-pathic establishments with considerable benefit as a derivative in cases of apoplexy and cerebral congestion, might prove useful in lunatic-asylum practice. After various experiments he resorted to it in a case of mania, and with such satisfactory results that he has since had recourse to this remedy very frequently when desiring to allay excitement or induce sleep. It is thus administered.

A quart of Durham mustard bran having been infused in boiling water for half an hour, the patient is placed in the ordinary hot-water bath (the privates being protected with a clean sponge), and the infusion then poured in through a coarse hair strainer, and well diffused throughout the bath. A blanket should now be arranged to retain the heat and fumes of the mustard, and the patient watched by the medical attendant. From ten to fifteen minutes will generally be found long enough to redden the skin slightly, and induce its free action, and as soon as this is obtained no time should be lost in wrapping the patient in a blanket, and placing him in bed.

Amongst the therapeutic effects of the mustard baths the following are most noticeable:—

(1) Excitement of the peripheral nerves; (2) determination of the blood to the skin; (3) derivation of the blood from the brain; (4) inclination to sleep; (5) increase of temperature; (6) lowering of the pulse; (7) diminished sensation; (8) diminished motor powers.

The excitement of the peripheral nerves is peculiarly persistent, evidenced by tingling sensations in the skin, sometimes lasting throughout the day following the bath. And

this persistent action is also seen in the hypnotic effect—two or even more nights of refreshing sleep resulting from one application. The skin usually acts very freely, so that it is advisable to guard against chills, and to allow the patient to remain in bed next day. The lowering of the pulse is not a constant feature, though its frequency will usually be found to be diminished from ten to twenty beats a minute.

Of its value as a hypnotic these two cases may be taken as illustrative:—

CASE I.—A young lady, labouring under acute mania, had been sleepless for seven nights previous to admission, in spite of the free administration of narcotics. She was placed in the mustard bath for twenty minutes, and thereafter enjoyed a refreshing sleep for five hours. Next evening the bath was repeated, and was followed by nine hours' sleep, the patient awakening comparatively rational, and expressing herself as feeling much more comfortable.

CASE II.—A middle-aged lady, suffering from recurrent mania with insomnia, is nearly always calmed by a mustard bath, the attacks being undoubtedly shortened, and sleep being readily gained.

The following illustrates the value of the mustard bath as a derivative:—

CASE III.—A gentleman in the advanced stage of general paralysis with epileptiform convulsions followed by lividity, unconsciousness, and rigidity, was treated by being enveloped in cloths wrung out of the mustard infusion covered with macintosh. In half an hour the face became pale, the rigidity passed off, and consciousness returned. And this effect has been noted and found of great service in many similar cases of general paralysis.

The cleanliness, safety, and efficiency of this valuable hypnotic and derivative merit a wider trial in asylum practice than it has hitherto obtained; and whatever persuasion is requisite to induce a patient to undergo this method of treatment for the first time will be quite unnecessary on a second occasion.

Abstracts of British and Foreign Journals.

On the Structure and Functions of the Nervous System.

DR. JAMES ROSS (*The Medical Times and Gazette*, Oct. 27, *et seq.*).—

The first paper is occupied with preliminary remarks on the proportion of living matter, the general conclusion being that nervous tissue is with respect to structure a mere differentiation of embryonic tissue, and with respect to function a specialisation of the common properties of all living matter. The next paper (Dec. 8th and 15th) deals more specially with the fundamental properties of the nervous tissues. Nervous tissues are composed of cells and fibres, the former originating and the latter conducting motion. The cells vary in size, and the larger the cell the more nearly related it is to the outgoing currents; and conversely, the smaller the cell, the more remote it is from these currents. Caudate cells with many processes and definite connections, are also in relation with outgoing currents, and occupy positions where numerous actions have to be grouped and co-ordinated. Bipolar cells occupy positions where the actions to be co-ordinated are few in number and uniform in kind. Cells with few processes, and without any definite connections, are in relation with the incoming currents. There are three kinds of nerve-fibres: the first being represented by an axis cylinder; the second by neurilemma and axis cylinder; and the third by neurilemma, medullary sheath and axis cylinder. The progress of development is from the simple to the complex; hence from the first to the third kind of fibre; and from the round cell without processes to the caudate cell with processes and definite connections. The first kind of fibre will be found where the actions to be grouped are diffused, the second where they are more definite, and the third where they are exceedingly definite. The third paper (Dec. 22nd and Jan. 12th) deals with the fundamental properties of the nervous system. The fundamental law of nervous construction is that as unlike parts have unlike functions, so

every distinct part of the organism will have a distinct function presided over by a distinct nervous centre. On the other hand, where structures, originally separate, have become fused in the course of development, their functions are also fused, and there is a similar fusion of their nerve-centres. The fourth paper (Feb. 9th and 16th), discusses the spinal cord. The white part of the cord which in the adult appears to be uniformly of the same structure, has, by embryological and pathological investigations, been analysed into six distinct systems for each lateral half. In a human foetus of a month old the cord consists of grey matter disposed round a central canal, and four bundles of fibres, two for each side; the anterior couple being disposed round the anterior and the posterior round the posterior roots of the nerves; hence they are called the anterior and posterior root-zones respectively. The grey substance (which may be called the "central grey tube") and the root-zones represent the spinal system, and are the only portions present in the amphioxus. Both of these vary in size according to the number and variety of the actions to be co-ordinated; the remaining portions connect the central grey tube with the cephalic centres, and they increase steadily from below upwards. Two of the remaining four systems may together be called the pyramidal fibres, inasmuch as they come together to form the anterior pyramid of the medulla. These fibres take origin in the cells of the central convolutions of the cerebrum, and pass uninterruptedly through the corona radiata, internal capsule, crusta, and pons, to reach the anterior pyramid of the medulla. A variable number of the external fibres of the pyramid pass directly down the cord close to the anterior fissure forming the column of Zürek. By far the larger proportion decussate with those of the opposite side, and proceed backwards and downwards to reach the posterior aspect of the lateral column close to the posterior cornu; hence these may be called the pyramidal fibres of the lateral columns. All the pyramidal fibres terminate in the cells of the anterior horns. A fifth bundle occupies the lateral surface of the cord external to the pyramidal fibres. These connect the cells of Clarke's column and the cortex of the cerebellum, and are called the direct cerebellar fibres. The sixth system is a wedge-shaped bundle called the column of Gall, which lies between the posterior root-zone and the posterior fissure; its fibres ascend and end in the nucleus of the slender fasciculus of the medulla, but their origin in the cord has not been ascertained. The anterior white commissure may probably be reckoned as a seventh system.

The Localisation of Cerebral Disease, being the Gultonian Lectures, 1878. First Lecture. DAVID FERRIER, M.D. (*British Medical Journal*, March 23 and 30, 1878.)—The obscurity and confusion which still embarrass the study of cerebral diseases, are to be attributed, in great measure, to the facts—(1) that many functional nervous disorders leave no discoverable trace behind them; (2) that interference with the brain at any one point tends to general functional disturbance; (3) that the discoveries of experimental physiology are not altogether consistent with clinical and pathological observations. The principles which must guide research, and determine conclusions, in the localisation of cerebral diseases are—(1) that one clear case in which destruction of a cerebral region caused no interference with the function assigned to it, must overturn a large amount of positive evidence in favour of this particular localisation; (2) that it is not always necessary, when certain functions are deranged, to show organic lesions in the parts in which these functions are localised; (3) that the symptoms observed with a cerebral lesion are not necessarily the result of derangement of functions in the parts immediately affected; (4) that any statement which contradicts our uniform experience must be regarded with suspicion, and received only when it has satisfied all the requirements of scientific evidence.

Brain functions may be investigated objectively and subjectively, and present themselves under physiological and psychological aspects. Brain diseases are manifested as mental aberrations, and as affections of motility and sensibility, but these classes of functions are rarely equally involved. Regarding the intimate pathology of insanity we know nothing, nor shall we attain to any practical acquaintance with it until the various morbid appearances, discoverable in the brains of the insane, are translatable into their subjective signification. Because large tracts of brain cortex may be destroyed without evident mental disturbance, and because any one part of the brain may be destroyed with a like negative result, it has been alleged that there is no localisation of function in the brain. But to show this it is necessary to demonstrate that the same part may be destroyed in both hemispheres without mental disturbance. But this has never been done. We have no evidence proving satisfactorily that even in a unilateral lesion the mental powers are unscathed.

Brown-Séquard has disputed the validity of the law of cross-action of the cerebral hemispheres, on the authority of two hundred cases of paralysis occurring with disease of the brain; but for

every case of direct, nine hundred and ninety-nine of cross-paralysis might be cited. All that is proved by these cases is that the law of cross-action is an approximative generalisation instead of an absolute rule. But in many of the cases of direct paralysis there were sources of fallacy, and the law of cross-action has an enormous preponderance of evidence in its favour. Paralysis, however, on the same side as the cerebral lesion, may be regarded as a possible occurrence on anatomical grounds. Flechsig has shown that the pyramidal strands are subject to considerable variations in respect to their decussation in the medulla oblongata. As a rule the most of the fibres of the pyramid descend in the postero-lateral column of the opposite side; the rest on the antero-internal of the same side. But occasionally the rule is reversed, and in one case there was no decussation at all.

Various attempts have been made to establish connection between lesions of certain cerebral organs and certain symptoms bodily or mental. Bouillaud with profound insight declared that several motor centres exist in the cerebrum. But to Hughlings-Jackson belongs the credit of having first indicated the motor functions of certain regions and given a rational explanation of the phenomena of unilateral cerebral convulsions. Instead of trying to account for the phenomena by transmission of some influence to distant motor regions, he regarded certain convulsions as themselves motor. No direct evidence could however be adduced in favour of this view until Fritsch and Hitsig showed in 1870 that electrical excitation of certain regions of the cortex invariably produced movements on the opposite side. In spite of innumerable attempts to degrade the grey matter of the brain and to exclude it from all share in the results, it may be regarded as established that its definite groups of cells yield definite effects always constant under definite stimulation of whatever nature. It is the great characteristic of the reactions which ensue on the application of the electrodes to the cortex that the results are definite, uniform and predictable when the electrodes are on one region, while there is a sudden transition to another movement equally constant, definite and predictable when the electrodes are shifted to a spot immediately adjoining the former. This remarkable and established fact is incompatible with the theory of physical conduction. Electrification of certain parts close to the basal ganglia, as the island of Reil, is absolutely negative, while electrification of more distant parts, as the postero-parietal lobule, produces immediate movement. This also is incompatible with the conduction theory, which is however mainly

rested on the observation that after removal of the grey matter, the application of the electrodes to the cut medullary fibres produces exactly the same movements as before. But there is plurality of causes. As well might we disprove in succession the motor functions of the corpus striatum, crus cerebri, spinal cord and motor nerves, because we can produce the effects attributed to their activity by direct stimulation of the muscles themselves.

The facts that the interval which elapses between an electrical excitation and a movement diminishes when the grey matter is removed, that under these circumstances a stronger stimulation is necessary than when the cortex remains entire, and that after a certain period the excitability of the medullary fibres denuded of cortex disappears, establish beyond doubt the relation of the cortical grey matter to movements.

Anatomical homologies must only be used in support of identity of functions with great caution. Experiments on the lower animals, such as frogs, pigeons, rabbits and dogs, give results but little in harmony with those obtained by experiments on higher animals which in conformation and habits most closely approach man. It may be shown, however, that in experiments on the cerebrum, what is true of monkeys is strictly true of man also. All experiments on different animals point to this conclusion, that the same movements are represented, though with different significations in different centres higher and lower. Volitional movements are those alone which are necessarily paralysed by destruction of the cortex; while automatic, instinctive or responsive movements are more or less completely and independently organised in the centres situated below the cortex. The conclusion to be provisionally drawn from the results of experimental physiology is that there are certain regions in the cortex to which definite functions can be assigned, and the phenomena of cortical lesions will vary according to their seat and also according to their character, whether irritative or destructive. In tracing out the effects of lesions of the human brain, the strictest topographical accuracy as to their position and limits is of vital consequence. For want of this, the great mass of old records of cerebral disease is valueless.

The frontal lobes, lesions of which are to be first considered, give no motor reaction when subjected to electrical irritation in the monkey. Destruction of these lobes causes no paralysis of motion or sensation. Many cases are on record of extensive lesions of these lobes in the human subject, with like negative results. One of the most remarkable of these is the American crow-bar case: A

young man, while blasting, had an iron bar, 3 ft. 7 in. in length, and $1\frac{1}{4}$ in. in diameter, propelled through his head, in a line from the left angle of his jaw to a point near the sagittal suture in the frontal region. Within an hour of the accident he walked up a flight of steps. He ultimately recovered, lived twelve and a half years, and died of epileptic convulsions. His skull has been preserved, and an examination of it leaves no doubt that the whole track of the injury was included within the pre-frontal region, and that, therefore, the absence of paralysis, which has been commented on by Dupuy, was quite in accord with the results of experimental physiology. But the man's mental condition was radically changed. The equilibrium between his intellectual faculties and animal propensities was destroyed. From having been shrewd, energetic, persistent, and sedate, he became weak, fitful, capricious, and profane. Similar cases have been reported by Bouillaud, Trousseau, Congreve, Selwyn, and others, all proving that sudden and extensive lacerations may be made in the pre-frontal region, and large portions of brain substance may be lost, without causing impairment either of sensation or motion.

Cases of softening and abscess in the same region give the same results. In some of these, however, the psychological condition has attracted notice. Lepine says of a case of abscess of the right frontal lobe: "He was in a state of hebetude, he seemed to comprehend what was said, but could scarcely be got to utter a word." Baraduc and Davidson have described cases of dementia following injury and atrophy of this region. Mental deficiency has been frequently noted in connection with arrested development of the frontal lobes.

Intelligent monkeys that have undergone removal or destruction of the frontal lobes retain their appetites and instincts, exhibit emotion, and preserve their senses and power of voluntary movement unimpaired; but they are apathetic and dull, do not manifest natural curiosity, are drowsy and listless, or indulge in purposeless movements. They seem to have lost the faculty of attention and intelligent observation, and the same kind of mental failure exists in general paralysis, in which morbid changes more particularly marked in the frontal lobes have been demonstrated.

A Human Cerebrum imperfectly divided into two hemispheres. PROFESSOR TURNER. (*Journal of Anatomy and Physiology*, vol. xii., January, 1878.)—The brain (which is figured) of an epileptic imbecile, who died in the Wilts County Asylum, presented

several points of especial interest and importance. The great longitudinal fissure was imperfectly developed; the two hemispheres were connected by mesial convolutions; there was only a single ventricular chamber, and the middle cornua to this ventricle were wanting; the corpus callosum, fornix, septum lucidum, velum interpositum and choroid plexuses were non-developed. To interpret the malformation of this brain by the usually accepted view that the cerebral hemispheres arise as distinct lateral vesicular offshoots from the anterior part of the wall of the anterior primary cerebral vesicle, we should have to suppose that the mesial convolutions were an excess of development of the grey matter in the longitudinal fissure. But the more recent and correct observations of His, and Mikhalovics—which show that the secondary fore-brain is at first an unpaired vesicle hollowed out into one undivided chamber, ultimately partitioned by a notch deepening into a furrow, and forming the great longitudinal fissure—enable us to understand that the unusual appearances in this brain are indications of an arrest and not of an excess of development. The great longitudinal fissure has only been imperfectly formed, and consequently the separation of the original unpaired hemisphere vesicle into two distinct hemispheres has only partially taken place. The grey matter which in the normal development would by the down-growth of the falx cerebri have formed the inner surface of each hemisphere has remained mesial, and constituted a connecting bridge across the fissure between the two hemispheres. The large primitive foramen of Monro has remained persistent, and the corpus callosum, fornix, and septum lucidum, all lying in the mesial plane, have not been formed. But notwithstanding the imperfect development in the mesial plane of the cerebrum, the grey matter on the surface of the hemispheres had assumed the arrangement into fissures, lobes and convolutions, characteristic of the human brain, and the mesial grey matter also had become convoluted. The basal ganglia were well developed, and the white matter of the corona radiata connecting these with the hemispheres was well formed, but the absence of the commissural fibres of the corpus callosum occasioned a diminution of the amount of white matter in the core of each hemisphere. The deficiencies in development enumerated had affected the size and weight of the organ. It weighed $39\frac{1}{2}$ oz., or about 10 oz. less than the average adult male European brain. It is not to be wondered at that this man exhibited evidence of imperfect intellectual capacity.

On the Expression of the Emotions. W. WUNDT. (*Revue Philosophique*, August, 1877.)—After a short and interesting historical introduction, in which we must note in passing a suggestive comparison between Gall and Lavater, Wundt briefly examines the work of the great English naturalist—Darwin. If, he says, we owe to Darwin some acknowledgment of the way in which he has proved certain general facts, we cannot fail to recognise the point at which habit, even combined with the constitution of the nervous system, is insufficient to give the key to emotional expression, because habit explains everything, and therefore nothing.

Wundt makes no distinction between the feelings and their kindred sensations. Language in its ordinary metaphors sanctions this view. We say, "hard necessity," "sweet melody," "black cares," "bitter troubles," or "dark destiny." These images have their origin in our sensibility. Our organs of sense are furnished with muscles, which have the double duty of affording the best reception to favourable impressions, and of keeping at a distance injurious agents. The mouth takes a different expression according as we taste a sweet fluid or swallow a bitter drug. Darkness, a too bright glare, soft daylight, each gives in turn a new expression to the face; one makes us open our eyes wide, the second causes us to knit our brows, the third imparts to our countenance an air of serenity. Hence it results that agreeable or disagreeable sentiments, joy, pleasure, esteem, fear, grief, scorn, are manifested by muscular contractions which recall on one side the action of grateful tastes or odours, or the brightness of a moderate light; and on the other bitterness, a stench, shadows, or a blinding dazzle. Reciprocally the expression gives rise to the feeling; the actor who simulates anger becomes to some extent angry. On the same principle depends another class of expressions—those gestures by which our ideas and representations are accompanied, and which serve to arouse in others similar ideas and representations.

Neuro-Syphilis. EDWARD WIGGLESWORTH, M.D. (*The Boston Medical and Surgical Journal*, February 28, 1878.)—As nervous diseases of syphilitic origin are more amenable to treatment than the corresponding idiopathic ones, a correct diagnosis may at times be sufficient to save a life which would otherwise be lost. Syphilitic affections of the nervous system are late forms. Traumatic injuries or depressing emotions act frequently as exciting causes, while a powerful predisposing cause is an unsystematic or insuffi-

cient treatment of the disease in its earlier stages. Cerebral syphilis may appear as (1) Successive hyperæmic attacks, with symptoms like those of general paralysis. (2) Syphiloma accompanied by paroxysmal and intolerable nocturnal headache, and by sleeplessness, especially in young persons, in whom insomnia from other causes is rare. (3) Disease of the arteries, followed by apoplexy or thrombosis, with necrobiosis and syphilitic hemiplegia, after which recovery under the best treatment is generally imperfect.

Two Cases of Nerve Stretching. DR. THOMAS G. MORTEN and DR. WILLIAM C. COX. (*The American Journal of the Medical Sciences*, January, 1878.)—Miss B. accidentally ran a pair of scissors into the outer side of her right wrist, and suffered in consequence intense pain in the hand and wrist, gradually involving the elbow, shoulder and side. The pain was never absent, but was subject to exacerbations, and was increased by pressure. The application of laudanum blisters, belladonna and aconite gave no relief. Sewing and writing were especially painful; there was also a sensation of numbness and cold in the hand. Three months after the injury an incision was made at the wrist, directly over and in the line of the ulnar nerve, which when isolated was found quite normal in appearance. The forefinger was passed under the nerve, and it was well stretched. When it was replaced it was seen to be considerably lengthened, and to present a wavy outline. The pain in the arm after the operation was intense, and in a few days an abscess formed in the upper part of the wound. For several weeks a feeling of numbness and tingling continued in the little and ring fingers and on the outside of the hand, but these symptoms gradually disappeared, and in a month all pain had ceased. No symptoms of impaired nerve-action followed, sensibility and muscular power remaining perfect. The second case was that of a carpenter, who, having fallen from a scaffold in 1866, suffered subsequently from concussion, difficulty of speech, paralysis of both legs, and acute articular rheumatism. The paralysis of the lower limbs gradually disappeared, but after it there came on excruciating pain in the sole of the left foot, with no swelling, constitutional disturbance, nor increase of pain on pressure. There was loss of sensation in the foot and half-way to the knee; temporary relief was obtained from morphia, but ultimately Dr. Casselberry excised a portion of the plantar nerves, which gave complete ease for seven years. In 1874, however, the pain recurred, and involved the leg as well

as the foot. By pain and morphia the patient's health became utterly broken down. On June 12, 1877, after etherisation, an incision was made over the sciatic nerve in the middle of the thigh, and then it was thoroughly stretched. For five days there were spasms of the muscles of the legs, with exquisite sensitiveness along the sciatic and popliteal nerves, but this gradually subsided. Pain in the old locality, however, still continued, and morphia was used daily. Some weeks after this, the suffering being very great, two inches of the external popliteal nerve were excised, and this is said to have given entire relief.

In the case of the ulnar nerve-stretching the increasing pain, which had not only involved the hand and arm but had extended to the neck and side, was entirely relieved by this operation, which inflicts far less injury than any nerve-excision. In the case of the sciatic nerve-stretching the operation did not give relief.

J. ORRINGTON-BROWNE.

The Influence of the Spinal Cord upon Animal Heat.
(*Archiv. de Phys. norm. et Path. n. 1 et 2, 1877, et Revue des Sciences Médicales.*)—M. Parinaud, finding that section of the spinal cord lowered animal temperature—a fact previously well established—formed this hypothesis. The effect is produced by means of two sets of nerves, the vaso-motor and the trophic. Paralysis of the former elevates the temperature; paralysis of the latter lowers it. The author rests this explanation upon the fact that section of the cord is followed by a lower temperature in the groin below the section than is observed in the axilla, above the section; the difference, however, not exceeding a few tenths of a degree. According to M. Parinaud, this diminution of temperature can be explained only by a lessening of the chemical combustions in the corresponding parts. The author explains the slower pulse and respiration after section, by supposing that the *necessities* of the chilled animal are fewer. Section of the cord does not act directly on the circulation, and after such a lesion the animal preserves in part the power of equilibrating its temperature. Disturbances in temperature are the same when the author divided the cord below the cardiac nerve, about the fourth and fifth dorsal vertebrae, as when the section was made at the level of the cervical vertebral. According to M. Parinaud, vaso-motor paralysis would explain the momentary increase of peripheral temperature observed immediately after section, and the considerable and persistent increase of temperature

often noticed in man after such lesions would be more probably due not to the section, but to the myelitis consequent on it.

[The author has originated an ingenious theory, but without offering much proof of its correctness.—Tr.]

Clinical Researches on the Motor Centres of the Limbs. (*Journal de Thérapeutique*, 1877.)—M. Bourdon cites under this title a large number of interesting observations. An elderly man, weakly, and suffering from atheroma in the cardiac valves and arteries, is suddenly seized, after a simple faint, with loss of speech and a paralysis limited to the muscles of one of the forearms, without loss of sensibility. The nature and onset of the seizure had led to a diagnosis of lesion in the cortical brain-substance near and probably in front of the fissure of Rolando. After death a small bloody extravasation was found behind the upper part of the ascending frontal convolution, on the side opposite to the paralysis.

M. Bourdon's conclusions from a large number of interesting facts are the following.

The motor centre for the arm in man occupies a zone of the cerebral cortex comprehending the two ascending convolutions, the frontal and the parietal, and neighbouring parts; and is not, as experiments made on the lower animals would seem to imply, a limited and clearly bounded region of this zone.

The movements of the legs would seem to be under the control of the highest part of this zone.

The movements of the face appear to depend upon the back part of the second frontal convolution, and on that part of the ascending frontal convolution which is in the neighbourhood.

Amputation of a limb induces in time *atrophy* of the part of the cortical substance on which its movements depend.

According to the author it follows from these conclusions that in cases of paralysis limited to an arm, and of cortical origin, a surgeon who should operate at the middle part of the fissure of Rolando, as M. Lucas Championnière recommends, would incur the risk of missing the exact point of the lesion, which might be considerably above or below that point. He however recognises the probability of success by following these instructions when persistent aphasia coexists with paralysis of a single arm; and in all cases the issue of M. Bourdon's investigations goes to show that Championnière's advice to trepan at the top of the line of Rolando in paralysis of the inferior extremity, is well founded. But the advice to trepan behind the line of Rolando

is criticised by Bourdon, since in three instances he has known the lesion to be in front of it. As showing the importance of being able to localise the parts of the brain affected in certain conditions, Bourdon details a case in which Broca diagnosed and opened with the trephine an abscess seated at the level of the third left frontal convolution.

A. RABAGLIATI.

On the Influence of the Cerebrum in the Production of Epilepsy.—In recent numbers of the *Archiv. Italiano*, Professor Albertoni publishes an interesting report of work done in the physiological laboratory of the University of Siena; he has himself been studying the causation of epilepsy, and describes sixteen experiments made upon dogs, cats, and rabbits in the course of his investigations.

1. *The Epileptic Fit.*—After removing a portion of the skull of a dog, and dividing the dura mater so as to lay bare the posterior central convolution (in which almost all the centres from which muscular action may be excited are situated), a very weak induction current is passed for a short time through the centre for both extremities. The current used is so weak that it may be passed through the tongue without causing pain. The animal is at once attacked by general convulsions, and lies unconscious, the subject of clonic and tonic spasms; the pupils are widely dilated and do not react to the stimulus of light; saliva flows freely from the mouth. The convulsions cease gradually, after about two minutes, the dog rises and wanders about purposeless, running against various objects, then lies down, taking no notice of anything near him. The experiment may be repeated two or three times upon the same animal with the same result, but the current must be a little stronger each time. Upon one dog the writer performed the experiment successfully seven times in one day. The results were the same, whether the right or the left hemisphere were exposed and acted upon, also when the dura mater was not divided but the rheophores applied outside it. In the same cases the animal uttered a cry at the commencement of the fit; sometimes urination took place. The author also succeeded in causing a fit by pressing the trephined portion of the skull in upon the cortex in the same situation.

2. The experiment does not always succeed upon dogs: this the writer is unable to account for; it never, according to Albertoni, succeeds in rabbits to the extent of causing a true epileptic fit,

notwithstanding Ferrier's statement to the contrary. In cats the epileptic attack can be produced as in dogs.

3. The epileptic zone, that is to say, that part of the cortical substance in which the slightest electric stimulus gives rise to convulsion, is entirely limited to the posterior central convolution. In other convolutions the fit can only be caused by the application of strong currents, which are probably transmitted to the posterior central.

4. Anæsthesia prevents the development of the epileptic fit. In proof of this, two experiments are given. A dog was put under the influence of ether, and the electrodes then applied to the epileptic zone; the usual movements of the opposite extremities and neck resulted, but there was no epileptic fit. As soon as the effect of the ether had passed off the electrodes were again applied, and a fit was at once produced. In the second case, a dog which immediately had a strong fit every time that the sensitive zone was stimulated by electricity, had a strong solution of chloral injected into the femoral vein; after this, strong currents were applied in the usual situation; the dog lifted his right extremities, but had no convulsion.

5. Five experiments were made upon dogs with the view of ascertaining whether the brain-cortex acts autonomously, or by means of a reflex in the causation of a fit. The epileptic zone was removed from each cerebral hemisphere; the electrodes being then applied, convulsions ensued, at first of the opposite side only, but they afterwards became general; after a short time no further reaction could be obtained. From this the author concludes that the cortical layers of the cerebrum do not themselves directly cause the epileptic fit, but that they do so by means of a reflex through the motor centres at the base of the brain.

6. The increase in the secretion of saliva during the epileptic seizure is due to stimulation of the sub-maxillary gland through the chorda tympani. Two experiments are adduced in proof of this.

On Atrophy of the Spinal Cord after division of the Spinal Nerves.—A series of experiments carried out by Drs. Bufalini and Rossi confirm Vulpian's statement that the changes in the spinal cord after partial or complete amputation of a limb, consist only in diminution of the size of the tissue-elements, and not in any qualitative change in them. This observation is opposed to Hayem's view that, as a result of physiological inactivity after amputation or simple division of the nerves, myelitis with destruction of the nerve-cells of the grey matter takes place.

On increase in the Cardiac Pulsations after irritation of the roots of the Upper Dorsal Nerves.—Albertoni and Bufalini find as a result of their experiments, that irritation of the roots of the first six dorsal nerves markedly accelerates the action of the heart, and that this takes place through the instrumentality of the sympathetic system. The same effect is produced when the blood-pressure is lessened by division of the spinal cord, or by the action of chloral.

Notes on the Objects of Sphygmography in Psychological Medicine.—This paper, which was read before the "Psychiatrischer Verein der Rheinprovinz," is reported in the *Allgemeine Zeitschrift für Psychiatrie*, Band 35, Heft 1.

Although sphygmographic observations are somewhat tedious and troublesome, the neglect of them is the less excusable now that they are every day playing a more important part in general medicine. Wolff's observations led him to the following conclusions:—(1) the normal pulse in incurable insanity is the "pulsus tardus;" (2) this pulse is to be regarded as an indication of the neuropathic constitution upon which the psychosis is developed; (3) patients who have apparently recovered, but still retain this peculiar pulse, have in reality not recovered at all. The author fully confirms the observation that in the insane, especially the incurable, a pulse-curve is generally found which belongs to the class described by Wolff. This circumstance, however, does not suffice to establish Wolff's other conclusions. When it is remembered that the latter observer included under the term "pulsus tardus" many more varieties of pulse-curve than Landois; also that his supposition that a paralysis of the vaso-motor nervous system was the cause of this variety of pulse, is not reconcilable with Landois' theory; it will be seen that other questions have to be answered before the results of sphygmography in the study of mental disease can be so explicitly formulated.

It is first necessary to determine whether the pulse in question may not sometimes be observed in perfectly sane persons. The author has made some observations with this object, but they are not numerous enough to justify any definite conclusion; he noticed, however, that in certain cases, young men who were strong, had good mental abilities, and were in no way diseased, exhibited abnormal pulse-forms, e.g., dicrotism; also that, especially among women, it is not at all uncommon to find the "pulsus tardus" in

various degrees. This led the author to suspect that perhaps the abnormality of the pulse in these persons might be due to feeble development of the muscular coat of the arteries, and therefore to a cause which has nothing to do with disturbed innervation or a neuropathic constitution.

Another subject of investigation should be the question as to how far the heart's action influences the production of the various pulse-phases. Wolff showed long ago that valvular disease produced corresponding changes in the pulse-curves, but it is desirable to know whether some more delicate changes in the heart cannot be shown to exist in some cases with "pulsus tardus." If the two conditions were found to co-exist, it could go far to deprive the pulse under consideration of its supposed nervous character. Combined observations with the sphygmograph and cardiograph would be not only possible, but would probably yield interesting results.

Suppose, however, that in a given case the existence of any abnormality either in the arterial muscular coats or in the heart could be with certainty excluded, and, in the absence of local causes, the appearance of a "tardy" pulse-curve might justifiably be ascribed to change in the innervation of the vessels; the question would still remain whether the vaso-motor disturbance was general or only partial, perhaps unilateral. To decide this, other arteries beside the right radial must be examined. Eulenburg and Mendel have made observations in this direction; the latter has published some very instructive comparisons between the radial and carotid tracings. The vaso-motor centre has always been assumed to be a double organ, and Eulenburg found in his experiments on the influence of injuries of the cerebral cortex upon vascular innervation that the effects produced were unilateral and upon the side opposite to the injury. It is easy to understand how high temperatures, poisons, or psychic impressions should cause the disturbance of vascular innervation to be general, but it would be difficult to explain how, in the course of a psychosis, the characters of the pulse-curve should be similarly affected in all regions of the body. A morbid change, of exactly the same nature, proceeding at exactly the same rate in each of the two halves of the central nervous system, would have to be assumed if it were held that this general and similar alteration in the pulse-tracings throughout the body were due to disturbance of the innervation of the vessels.

CHAS. S. W. COBBOLD, M.D.

BRAIN.

JULY, 1878.

Original Articles.

REFLEX ACTION AS A CAUSE OF DISEASE AND MEANS OF CURE.

BY T. LAUDER BRUNTON, M.D., F.R.S.¹

As a preliminary to the paper of this evening upon reflex action as a cause of disease and a method of cure, I must say a word about reflex action itself, and also about another subject with which it is very closely connected, viz. the transference of impressions.

Reflex action is the effect produced by an impression made upon a sensory nerve, transmitted by that nerve to a nerve-centre, and reflected or thrown back along a motor nerve in much the same way as we may imagine the force to be which is applied to one end of a string running over a pulley and transmitted in a different direction by the other end to produce a certain effect. If we fancy the further end of the string to be divided into several strands, each of which is attached to a different object, and which may be, separately or together, affected by a pull on the nearer end of the string, we shall form a still more definite notion of reflex action, for an impression made upon the same sensory nerve may produce various results, according to the strength of the impression

¹ Read before the Abernethian Society, St. Bartholomew's Hospital.

and the efferent nerve channel along which it is thrown back by the nerve-centre. An impression made upon a sensory nerve, for example, may produce motion of either a voluntary or involuntary muscle, or may affect the nutrition of a tissue. Under the head of involuntary muscles we must class the muscular fibres of the vessels, and those vascular changes which in themselves play a great part in nutrition and secretion may be very greatly influenced by impressions made upon sensory nerves. The way in which we know that the nutrition of a tissue may be influenced reflexly apart from the changes in the vessels is, that observations on the submaxillary gland have demonstrated that we may, under certain conditions, obtain vascular changes without the secretion which usually accompanies them, and that, *vice versa*, we may obtain secretion without the vascular changes which ordinarily accompany it. Thus, on stimulating the nerves of the tongue, the impression which we make is usually transmitted by the fifth nerve to the brain, and is thence reflected down the chorda tympani to the submaxillary gland. There it induces dilatation of the vessels, and free secretion of saliva from the gland; but if we administer atropia we do away with one of these results, while we leave the other as it was—we completely arrest the secretion, but we allow the vessels to dilate as before. If, on the other hand, we employ physostigma, we contract the vessels, but cause great secretion, such secretion as is usually accompanied by dilated vessels and the free flow of blood through the gland. It is evident, then, that vascular changes, although usually associated with alterations in nutrition, do not necessarily cause them; and that, in the gland we have just mentioned, changes in the tissues composing it will occur without the calibre of the vessels or the flow of blood through them undergoing any material alteration.

We will now say a word about the transference of impressions. Just as we may imagine the further side of the cord passed over the pulley to be divided into different strands, while the nearer side is single, and as we imagine different results obtained by pulling upon the single string by reason of those subdivisions at its further end, so we may have the

nearer end of the cord subdivided into strands, while the further end is single, and thus we can obtain a similar result by pulling any one of the strands on the nearer end. This simile may serve to illustrate the way in which we may obtain a similar result by irritation of various efferent nerves, the stimulation being conveyed to the nerve-centre and reflected down the same efferent nerve in each case. For example, a small grain of sand in the eye will cause a person to wink violently and involuntarily. In this case the impression made upon the sensory nerves of the conjunctiva is transmitted up to the brain, and reflected down the motor nerves of the orbicularis palpebrarum. But some time ago, after the extraction of a tooth, and while the wound in the gum was healing, I observed a twitching of the corresponding eyelid somewhat resembling that which would have been caused by a grain of sand in the eye. Here, also, we have the motor nerves of the orbicularis reflexly excited, but the strand, if we may so term it, through which the stimulus was sent up to the nerve-centre was not the same, for in this case it was a dental, and in the other case an ophthalmic branch of the fifth. With these general remarks on reflex action and transference of impressions, we will now proceed to consider some cases in which reflex action is a cause of disease. I have just mentioned one instance in which intermittent spasm of a voluntary muscle, the orbicularis palpebrarum, was caused by irritation of a sensory nerve. This leads me to remark that a very important condition to be borne in mind is that constant stimulation of a sensory nerve will often produce clonic or intermittent, and not tonic or continuous, contraction of the muscles which it may set in action. It was observed by Nothnagel that if the sciatic nerve of a frog's leg was subjected to constant stimulation under certain conditions, the contractions which it induced reflexly in the other leg were intermittent or spasmodic, but not continuous or tetanic. Another instance in which voluntary muscles are reflexly affected is seen in the acts of coughing and vomiting. Coughing is adapted for the purpose of expelling irritating substances from the respiratory passages, and thus preventing their injuring the organism, just as the act of winking is adapted to remove injurious

substances from the eye. Coughing is usually excited by irritation of the nerves of that part of the body from which the irritant is to be removed. But coughing, like winking, may be reflexly induced by other nerves than those which usually excite it, and thus may prove hurtful instead of useful. Thus, in pleurisy, irritation of the pleura causes the same expulsive efforts as a foreign substance in the bronchi, although those efforts can expel nothing, and only cause pain to the patient; and even when the act of coughing is induced from the ordinary nervous channels, but where the irritant, like tubercle in the lungs, cannot be removed, the act is likewise injurious. In the same way, vomiting is most frequently induced by the presence of irritating substances in the stomach, and proves useful by causing their rejection and thus relieving the stomach of their obnoxious presence. But when the irritation is due to inflammation of the walls of the stomach itself, the expulsive efforts of retching are quite useless, and only exhaust the patient. Here, too, the act of vomiting can be induced by irritation of other nerves than those of the stomach itself. Irritation of the pharyngeal branches of the glosso-pharyngeal and of the pulmonary branches of the vagus, irritation of the hepatic nerves by the passage of a biliary calculus, irritation of the renal nerves by a calculus resting in the kidney or passing down the urethra, irritation of the intestinal nerves (as, for instance, by incarceration of a hernia), irritation of the uterine nerves by the presence of a foetus in the womb, or of the ovarian and vesical nerves by inflammation of the ovaries or bladder, may all produce vomiting; and in all, or nearly all, these cases, efforts at emesis will be productive of no beneficial result. When the irritation is further down the intestine, as when an ulcer is situated in the rectum, there is a constant desire to go to stool, but the only results of the expulsive efforts involved in its gratification are exhaustion of the patient and aggravation of the ulcerated condition. In the efforts of micturition, as in those of vomiting and defecation, we have combined movements of voluntary and involuntary muscles. The urine is retained in the bladder by the contraction of the sphincter surrounding its neck, and it is expelled by contraction of the body of the bladder itself with

the assistance of the abdominal muscles. Both the sphincter of the neck of the bladder and the muscular walls of the organ itself may be reflexly excited to contraction, and we may thus have reflex incontinence or reflex retention. One of the most common causes of incontinence of urine, for example, is the presence of ascarides in the rectum; and while the ascarides remain, we may employ drugs to cure the incontinence without success. An interesting case is described by Mr. Teevan in the *Practitioner* for Oct. 1876, where a boy had been treated in vain by medicine, but was at once cured by healing a fistula *in ano* from which he had been suffering, the irritation produced by it appearing to have been the real cause of the incontinence.

We will now pass from reflex changes in the respiratory and intestinal tracts, to reflex changes in the blood-vessels and heart. It is well known that, usually, irritation of a sensory nerve causes dilatation of the vessels in the part supplied by that nerve, and contraction of the vessels in the other parts of the body. This may take place without any alteration whatever in the beats of the heart itself; but if the irritation be very strong, or applied to certain nerves, the heart also may be acted upon. There seem to be certain nerves which act more readily upon the heart than others, and more especially is this power possessed by the fifth nerve, the roots of which are very closely associated with those of the vagus. On stimulation of the branches of the fifth nerve passing to the nose in animals—as, for example, by holding ammonia, strong acetic acid, or chloroform before the nose of a rabbit—the beats of the heart may be suddenly and completely arrested. To a similar arrest of the cardiac pulsations by irritation of the dental branches of the fifth, I attribute the numerous deaths which have occurred through the extraction of teeth under chloroform. It is probable that the extraction of teeth would, under all circumstances, be an exceedingly dangerous operation, were it not that in the waking condition irritation of the dental nerves sets in motion two pieces of mechanism, one of which, to a great extent, counteracts the effects of the other. As I have already mentioned in a former paper, I was once asked how it was that the application of ammonia or acetic acid to the nose of a

fainting person was proved by experience to be beneficial, when theoretically it ought to be injurious by arresting the already enfeebled heart. The answer to this is, that ammonia or acetic acid, held before the nose of a fainting person, by irritating the branches of the fifth nerve, does not act upon the heart alone—it causes contraction of all the vessels of the body, and thus keeps the arterial system full, and the blood-pressure high, despite the diminished current poured into it by the flagging heart. So much is this the case, that I have found in an animal in which the heart was weakened and the vessels dilated by shock, that the application of ammonia or acetic acid to the nose raised the pressure by one-fourth of the whole. In the ordinary waking condition, the sudden stimulus of extracting the tooth has its effect upon the heart completely counteracted by the coincident contraction of the arterioles throughout the body which it also causes. In chloroform narcosis, however, these two reflexes are not influenced equally by the drug, and the reflex upon the heart may remain after the reflex action upon the vessels has been abolished, so that the heart may stop, and death will then ensue, for, the capillaries being no longer contracted, the blood at once drains out of the arteries into the veins, and circulation ceases. Another very important reflex upon the heart is that which is effected through the solar plexus and the sympathetic nerve. A stroke upon the belly will through these nerves stop the heart, dilate the vessels, and induce the most serious conditions of shock, killing the patient, or at any rate bringing him down to death's door. The most important nerves through which the vessels are reflexly contracted are the splanchnics, and the contraction of the abdominal vessels which they supply has much more effect in altering the general pressure of blood throughout the arterial system than the contraction of any other vascular district in the body. But although the abdominal vessels are the chief ones concerned in alterations of blood-pressure, yet local alterations in the various organs may have an even more powerful action upon the nutrition of these organs themselves: for it is probable that although the abdominal vessels may be caused to contract by powerful stimulation of almost any sensory nerve, yet that the blood-vessels in different organs

of the body—such as, for example, the kidneys or mucous membranes—are more affected by irritation of some nerves than of others. The researches of Sanders-Ezn have shown that stimulation of certain sensory nerves, or of limited districts of the skin, will induce definite muscular action due to contraction of limited groups of muscles. It is probable that irritation of limited districts of the skin also induces contraction of limited groups of involuntary muscular fibres or of limited districts of vessels. It is well known that tonsillitis is much more frequently produced by exposure to a draught which strikes the back or side of the head than by a current of air meeting one full in the face, or even by long-continued exposure to a storm in the open air. The cause of this has not yet been satisfactorily ascertained, but it has been attributed with some probability to irritation of the nerves of the ear by the cold current of air. When the throat is irritated, the irritation is not unfrequently felt in the ear; and *vice versâ*, it seems probable that irritation in the ear may cause alterations in the throat. It has been observed that pressure upon the floor of the external auditory meatus in a person who had suffered from otorrhœa produced violent or uncontrollable coughing; and if irritation of the ear thus produces a motor reflex like that of irritation of the larynx, it seems probable that it may also produce a reflex trophic disturbance similar to that which would have followed the direct application of an irritant to the larynx.

Congestion of the kidneys in horses is caused by exposure of the loins to rain, the action of cold upon that district of the general surface having a peculiar effect upon the kidneys, not produced by its application to other parts of the body. It is stated by Sidney Ringer upon Brown-Séquard's authority that blistering the loins will cause contraction of the vessels of the kidney, but I have not been able to verify this quotation. But though there seems to be a peculiar relation between the loins and the kidney, the renal circulation would appear to be affected by other nerves. Thus, for example, in a case narrated by Dr. Griffith at a meeting of the Medical Society of London, albuminuria was produced by the application of a dressing to an anal fistula, which ceased when the dressing was

removed, and again appeared on its re-application. In this case, the vessels of the kidney seem to have been reflexly affected by the irritation applied to the anal nerves to such an extent as to produce albuminuria, although probably no organic disease of the kidneys themselves was present. Exposure of the abdominal walls to rapid changes in temperature may bring on diarrhoea, as the natives of India well know. It is possible that in these instances the cold acts through the abdominal walls upon the intestines themselves; but it seems also highly probable that some part at least of the action is reflex from the surface of the abdomen. Whatever the cause of it may be, however, it may be guarded against by wearing a cummerbund, like the Hindoos; and it is well for persons who are subject to diarrhoea to wear, even in this country, a warm woollen or silken belt around the abdomen.

Irritation in the intestines may induce, not merely vomiting and diarrhoea, but even general convulsions, and cases are on record of epileptic fits having been produced by the presence of a tapeworm in the intestine, which ceased upon the expulsion of the intruder. Hysterical fits, although their pathology is far from being understood, are now becoming to some extent associated with ovarian irritation; for it is found that, in many cases of hysteria, the ovaries are tender upon pressure, and that the hysterical fit may frequently be instantaneously arrested by pressing upon the ovaries.

We have, so far, been dealing chiefly with reflex action as a cause of disease, but now we must say a word or two respecting the transference of impressions. It is well known that persons who have had their legs amputated often complain of cold feet, or of pains in their toes, on change of weather. The irritation here is really in the end of the divided nerve in the stump. But the brain is accustomed to refer all impressions made upon a nerve during its course to the terminal filaments from which impressions usually come, just as we feel a tingling in the fingers when we pull upon or jar the ulnar nerve, or, as it is popularly termed, the funny bone. In disease of the hip, the irritation is felt, not so much in the hip itself, as in the knee.

In headaches one can frequently trace the origin of the pain

to some point at a distance from the aching part. Some years ago I met with a case which was to me very instructive. A woman complained of a headache situated in the left temple. One of her teeth at the same time ached somewhat, and I gave her a pledget of cotton wool, dipped in solid carbolic acid, to put into the cavity. To my disappointment, it had little or no effect; but five minutes afterwards, on the removal of the cotton wool to the cavity of a second tooth, likewise decayed, but which had not at first been suspected as the cause of the mischief, the pain disappeared entirely from the temple. Some time afterwards, I was led to discover an unsuspected decayed spot in one of my own teeth, by a headache in the temporal region. I had noticed that during these headaches there was generally tenderness over the aching part, and that there was also a tender point at some little distance, usually the eye, which was tender to pressure. On this particular occasion, however, there was no tenderness of the eye, and I felt all along the side of the cheek and under the jaw to see if I could discover a second tender spot. Under the ramus of the jaw I found a small gland, painful on pressure. As glandular irritation almost always indicates something wrong in the lymphatics which pass to the gland, I at once suspected something in the mouth to be the cause of the tenderness. As there was no abrasion or tenderness of the mucous membrane of the mouth or tongue, I took a pointed instrument, and tested each tooth successively. At the very back of the crown of the last molar, I detected a small point which was tender upon pressure, and on going to a dentist I was informed that the point was just beginning to decay. Had it not been for the headache, this would have passed unnoticed, as the tooth itself had, up to that period, given me no inconvenience whatever. Headache over the eyes, although frequently depending on gastric irritation, is not unfrequently caused by straining the eyes, and is only to be removed by lessening the work which these useful organs have to perform. One finds this headache over the eyes in men who work much with the microscope, or in women who are engaged in fine needlework. Yesterday I met a case of this sort in the surgery. This was a woman who had been accustomed to work about her house,

but who began to work at dressmaking three months ago ; her hours of work being from 9 A.M. to 9 P.M., with an interval of an hour for dinner in the middle of the day. About two months ago she began to suffer from headache above her eyes, which makes her sometimes feel quite giddy. It gets worse in the evening about seven or eight. The headache here, it will be observed, came on about a month after the eyes had been subjected to this unaccustomed strain ; and it became worse in the evening after the darkness rendered artificial light necessary, and thus increased the visual strain.

Having said so much on reflex action as a cause of disease, we will now consider it as a method of cure ; and the first instance that suggests itself to our minds is the beneficial effect of a blister. Two theories have been proposed to account for the action of a blister. One is, that it dilates the vessels of the skin in the part to which it is applied, and by thus drawing away some of the blood from the inflamed organ below, lessens the pain and inflammation in it. The other theory is, that the blister acts reflexly upon the organ itself. The first of these suppositions is very improbable, because the amount of blood in the skin covered by a blister is exceedingly small, and, moreover, does not come from the inflamed organ, with which the blistered piece of skin may have little or no vascular action. The second theory is much the more probable one, but it is not yet certain how the vessels of the inflamed organ are affected by the blister. We do not know whether they are dilated or contracted. It is most likely, however, that they are contracted, the contraction lessening the pressure of blood upon the inflamed tissues, and thus diminishing the pain in somewhat the same way as we relieve the throbbing in an inflamed finger, by holding the hand above the head, or by compressing the brachial artery. This is rendered probable by the experiments of Zülzer, who found that when a blister was applied to the back of a rabbit for a length of time the skin and the muscles immediately below it were red and congested, but the deeper layers of the muscles, the pleura, and even the lung on the same side, were pale and anæmic. There are few inflammations of the internal organs in which blisters to the surface are not serviceable, but much has yet

to be done to ascertain the exact points at which they ought to be applied in order to produce their maximum effect. Thus, it is said, that in sciatica a blister to the heel will sometimes afford relief, while one applied in the neighbourhood of the nerve itself has little or no effect.

The effect of poultices is probably different from that of blisters, although ultimately productive of similar relief; for if we again take the simple instance of a finger inflamed in consequence of a thorn having run into it, we find that we can relieve the pain in two ways, either by putting the hand into cold water, or by plunging the finger into a warm poultice. Both of these measures, apparently so dissimilar, will produce a like result in regard to the inflamed point; that is, both will lessen the pressure of blood in the vessels where stasis has already taken place. The cold, applied to the whole of the hand, will cause the arteries leading to the finger to contract, and will thus diminish the supply of blood to the inflamed part, and lessen the pressure in the blocked capillaries. The warm poultice will also lessen the pressure, not by diminishing the flow of blood to the part, but by dilating the vessels around the point of stasis, and affording the blood a ready exit into the veins. In the case of internal organs, the blister applied to the skin probably acts like the cold applied to the finger, while the warm poultice placed upon the surface of the thorax or abdomen affects the deeper lying organs in the same way as it does the superficial ones, the warmth penetrating through the thin thoracic or abdominal parietes. On this account, when we wish to relieve pain in the chest or belly, we ought to make our poultices in a particular way. The common practice of mixing the linseed-meal with hot water, and applying it directly to the skin, is quite wrong, because if we do not wish to burn the patient we must wait until a great portion of the heat has been lost. The proper method is to take a flannel bag (the size of the poultice required), to fill this with the linseed poultice as hot as it can possibly be made, and to put between this and the skin a second piece of flannel, so that there shall be at least two thicknesses of flannel between the skin and the poultice itself. Above the poultice should be placed more flannel, or a piece of cotton wool, to prevent it

from getting cold. By this method we are able to apply the linseed-meal boiling hot without burning the patient, and the heat, gradually diffusing through the flannel, affords a grateful sense of relief which cannot be obtained by other means. There are few ways in which such marked relief is given to abdominal pain as by the application of a poultice in this manner.

Besides blisters and poultices, there is a third class of remedies acting reflexly, which is often too much neglected or despised, but is of exceeding service; I mean plasters. In chronic bronchitis, a plaster on the chest affords great relief, the plaster employed being either the simple pitch one, or the *emplastrum calefaciens* of the British Pharmacopœia. The pain in the chest just under the mamma, which is so often associated with anæmia and leucorrhœa, is relieved in the most remarkable way by the application of a belladonna plaster, and the same application also relieves when the pain is dependent on organic disease of the heart. The pain in the back, also, which is associated with leucorrhœa and uterine disturbances, is greatly eased by the application of a pitch plaster, or by a strip of *emplastrum calefaciens* placed along the lower part of the spine. In place of this, the *linimentum sinapis*, put upon a piece of spongio-piline four or five inches broad and ten or twelve inches long, has recently been recommended by Dr. Gamgee. The cause of the pain in the back is not known, but Dr. Gamgee's theory is that it is due to exhaustion of the lumbar portion of the spinal cord, that part from which the nerves for the urinary and genital organs are derived. In order to repair this exhaustion, he thinks that the supply of blood should be diminished, because functional activity is usually associated with rapid circulation, while the opposite condition of partial anæmia occurs during the period of rest and repair. To obtain this partial anæmia, he employs counter-irritation, differing from that of the blister in being less intense and more prolonged.

Such are a few of the more prominent instances of reflex action, as a cause of disease and a means of cure. To enter fully into all of them would occupy more time than the Society can afford, and to explain them satisfactorily would require more knowledge than I either possess or am able to obtain.

NOTES ON THE SYMPTOM-SIGNIFICANCE OF DIFFERENT STATES OF THE PUPIL.

BY JONATHAN HUTCHINSON, F.R.A.S.,

*Senior Surgeon to the London Hospital, and Surgeon to the Royal London
Ophthalmic Hospital.*

(Continued from page 13.)

In the former part of my paper I have discussed briefly certain general principles in reference to changes of the pupil, and have especially attempted to give precision to the terms which we employ. It will probably be convenient in what I have to say further, if the remarks are arranged under the head of the several different diseases in the course of which it becomes important to examine the state of the iris and ciliary muscle. In doing this I must premise that I by no means aim at an exhaustive *résumé*, but shall content myself by referring only to those subjects which suggest remarks of clinical interest.

Loco-motor Ataxy and allied conditions.

There appears to be a widespread belief that the pupils of loco-motor ataxy are usually small, and in advanced cases very small. From the omission of authors to make any special statements as to the condition of accommodation, we may probably assume that the ciliary muscle usually escapes. The inference from these facts is easy, that the third nerve is not involved, and that it is the ~~vaso-motor~~ which is paralysed, paralytic myosis being the result. Temporary defects of the third, as of other cranial nerves, are well known to be common;

but the symptoms which denote them usually pass away after a time, often after a short time. Thus ptosis, dilated pupil, and cycloplegia, one or all, may be present for a time in the early stage, but only exceptionally persist. On the contrary, the failure of the vaso-motor, as denoted by myosis, rarely disappears, and often tends to slowly increase. Nor is it without its interest to remark that we sometimes encounter symptoms in the viscera which imply vaso-motor paresis. The bowels are often very sluggish, and a torpid state of the bladder (bladder-constipation) is still more frequent and remarkable. There is no defect of the sphincters, and retention of urine to the extent of requiring the catheter rarely happens; but the patient will often find his bladder remarkably tolerant of large quantities, and will confess an inability to commence the act of micturition quickly, and to complete it with energy. This condition of partial cystoplegia may render its possessor quite unable to make water excepting in the erect position. It sometimes alternates with irritability of the bladder. Certain forms of failure of the sexual function, which are so frequently met with in association with iridoplegia and cystoplegia, are also very probably dependent upon disease in the vaso-motor system.

I have not had frequent opportunities for examining the pupils in advanced stages of loco-motor ataxia; but in the earlier periods, and especially in those cases in which the disease is suspected to be due to syphilis, I have seen many examples. Some of the more interesting of these I will briefly relate by way of illustration. It will be seen that smallness of pupil is by no means without exceptions.

A gentleman, aged about 40, has for four years suffered from the characteristic pains of loco-motor ataxy. His gait is unsteady, and he has noticed that in closing his eyes to wash his face he is liable to fall forwards. It is doubtful whether he is syphilitic. He had a sore of very brief duration twelve years ago, but no constitutional symptoms then or since. His pains are, as usual, very much influenced by weather. He has long-standing, hard-edged ulcers in the soles of his feet, suspicious but not certainly syphilitic, the state of which varies with his pains. It is for these that he consulted me. He has

a weak bladder, irritable bowels, and *almost motionless pupils*. His right pupil is absolutely motionless to light, the left moves a little; both are larger than natural (Nos. 8 and 9), the right being the larger. He says that as long as three years ago his wife told him that his right pupil was larger than the other, and this date would fit with the beginning of his ataxic symptoms. He has no appreciable defect of accommodation, and can read No. 1 with either eye.

This case, in which the ataxic symptoms are very definite, seems to prove as regards the iris: 1st, that the paralysis may be very slowly progressive; 2nd, may be attended by slight dilatation instead of contraction; and 3rd, may occur in one eye before the other. It is by no means improbable that the changes producing the iridoplegia are in the lenticular ganglion, and that the escape of the ciliary muscle may prove to be only a question of time.

In the following case the conditions are somewhat different, but we have the same fact of a large pupil, with symptoms of ataxia. A boiler-maker, aged fifty-two, who has eight children, and who denies syphilis, has been ailing for a year or more. His right eye has been injured, and we cannot examine with accuracy the state of its iris; but in the left there is cycloplegia, with mydriasis. The left pupil, as large as No. 9, contracts a little on exposure; accommodation is wholly lost, but with a suitable glass he reads the smallest print. None of the other branches of the third nerve are implicated, and we may conjecture (with some hesitation) that the ciliary ganglion is the seat of the disease, its vaso-motor elements having as yet escaped. The man, although looking well, complains much of the numbness of his hands, and of pains in his head and legs. He suffers much from cramp, and sleeps very badly. He can walk fairly well, but feels giddy with his eyes shut. His bladder is weak but often irritable, and his feet, usually hot, are liable occasionally "to go as cold as a snow-ball." He assured me that his sexual functions were perfect, but his wife said that they were almost in abeyance. His symptoms dated pretty nearly from his second marriage three years ago. He had not been intemperate, but had smoked heavily.

If a rather small pupil is quite motionless on sudden exposure to bright light, but contracts a little when the patient is made to accommodate or to converge the eyes, I think it may be assumed that the vaso-motor filaments to the dilator are paralysed, and that the third is probably intact. I have such a case now under observation, and the man has in addition to his fixed pupils total paralysis of the right sixth nerve, and almost total deafness in the right ear. He had syphilis many years ago. He has no other indications of defect of the vaso-motor. His pupils are about No. 3—that is, not very small. In such cases there is usually further evidence that the third nerve is not paralysed, and that the disease is not in the ciliary ganglion, in the fact that the function of accommodation is retained. We may note three stages in the completeness of iridoplegia: 1st, inability to respond to the influence of light; 2nd, inability to act during convergence of the eyes; 3rd, inability to act under stimulation by atropine and Calabar bean. These stages are probably usually developed *seriatim*. The first is common in cases in which the second and third are yet absent, and the first and second may be present without the third. Inability to respond to direct stimulation by drugs is very rare indeed, and probably occurs only when all the peripheral ganglion structures (lenticular ganglion and choroïdal ganglionic cells) are destroyed.

It would seem highly probable that these peripheral structures are capable, to some extent, of originating tension or force, and that they may sustain the functional activity of the iris and ciliary muscle in cases in which the sources of central supply have been much damaged. This is probably possible in a greater degree in the case of the ciliary muscle than in that of the iris. If the third nerve be absolutely destroyed, then paralysis of the circular fibres and of the ciliary muscle must result. If, however, in place of absolute destruction, the nerve be only enfeebled by disease in its nucleus, then it seems possible that whilst the recti fail to a very considerable extent, the iris and ciliary muscle may remain fairly vigorous. Such was the condition of things in a man (Burton) who was the subject of symmetrical ophthalmoplegia externa, and could only to the very slightest extent use

any of his recti. He could accommodate well, and his pupil acted, not perhaps quite normally, but still very fairly. It is to be noted that at the time of this observation the levators of his upper lids had almost wholly recovered. At a former period complete ptosis had been present, but I believe he had never lost accommodation.

Another man under observation at the same time had lost symmetrically the superior and inferior recti, and had imperfect ptosis, but retained perfect power of accommodation, whilst his pupils, motionless to light, acted only in concert with the internal recti.

A very rare condition, in which the final stage of absolute iridoplegia under all forms of stimulation was nearly attained, presented itself in the person of an elderly clergyman. This gentleman had been under treatment for some years for myosis, and had been enabled to read much more easily by the continuous use (for four years) of weak solutions of atropine. He was myopic, and thus had felt the inconvenience of cycloplegia less than would otherwise have been the case. In spite of his myopia, however, he constantly used + 16 for reading. By atropine every night he had kept his pupils at No. 2 and No. 3 respectively, the left being the larger, and both quite motionless. By using a 4-grain solution every three hours for one day, we dilated them to No. 3 and No. 4 respectively, but not further. The left (the larger one) was oval. Now this patient's history was very interesting. Thirty years ago he had been under much treatment (Mr. Guthrie and others) for widely-dilated pupil on the left side. After resisting treatment for long, the mydriasis gave way to myosis, and both pupils contracted until very small. For this condition atropine became necessary. There were no indications of loco-motor ataxy, and Mr. M. seemed in good health. He had, however, a few years ago experienced a fit of depression, which obliged him to leave business, and he has for many years had muscular twitchings in the face. Some years before his mydriasis he had syphilis. Both his eyelids drooped at the time I saw him so as to almost cover the pupils, but he did not complain of this, and he did not remember to have ever suffered from squint, double vision, or ptosis. We may conjecture that in him the ciliary

ganglion is destroyed, and the ganglionic cells in the choroid implicated.

The following case is one of the most important in reference to the clinical meaning of myosis which has ever come under my observation, and I must trespass on the reader's patience with rather full details as to the conditions which accompany the iris symptoms. The case is probably one of ataxia from syphilis, but the facts would suggest rather strongly that the vaso-motor system of nerves is the part chiefly affected. The man has extreme myosis ("pin-head"¹ pupils), which has slowly advanced, and with it he has indications of general derangement of circulation-force, loss of power in the bladder, and liability to attacks of temporary paraplegia. That the paraplegia is not due to spinal disorganisation is rendered certain by the circumstance that it passes off almost completely, and even within so short a time as a few days. Extreme susceptibility to the influence of cold, and benefit from the use of warmth, are very prominent features in the case. With regard to the significance of the pupils, let me especially note that they do not imply disease of the ganglion—since accommodation is perfect, and the circular fibres active,—but rather disorganisation of the vaso-motor filaments alone.

A man named H——, aged 44, was kindly sent to me by Dr. Hughlings-Jackson that I might examine his pupils. He was under the care of Dr. Milner Fothergill, by whom he had been referred to Dr. Jackson, and whose permission I have to publish the following notes. The chief facts of his case were the following:—In early life he masturbated, and his sexual functions have never since been very vigorous; and he has, as he considers, always been very nervous in connection with that cause. In 1862, when he was twenty-nine years of age, he contracted syphilis. His eruption lasted a long time, and was finally cured at Blackfriars by Mr. Startin. He believes that he took the iodide at this time for nearly a year. Soon after his cure he had joint pains, which were called "gonorrhoeal rheumatism," and from that time to the present he has never been long free

¹ In my scale (see page 4), No. 0 is "pin-hole" (rather large), and No. 1 is "pin-head."

from pain in one or other part. The kind of pain from which he has suffered has, as I will tell you presently, varied a good deal. Of late years his pains have got worse; he has been weaker, and, what is very important, he has had two temporary attacks of paraplegia. Finally, his pupils have contracted until the right is little more than a pin-hole, and the left only about twice as large. It will be seen that I have suggested two possible causes for the progressive failure of nervous functions from which this man suffers. It may be a consequence of sexual atony such as follows from premature and excessive excitement of the functions, or it may be from syphilis. I have now to allude to a third possible influence; and to state that he has smoked heavily and drank spirits freely. In spite of all these influences, he is a healthy-looking man, though rather pale.

The affection of the nervous system is in one sense universal, but it falls with especial stress on certain parts. Every kind of exertion fatigues the organ employed. If he walks far his legs ache, if he speaks long or reads aloud, his voice fails, and if he looks much at anything his eyes become painful and tired. No part of his body is comfortable: his skin feels tight, or tingles, or smarts, or is numb at different times; his head always aches more or less, and he has especially severe aching pains in his jaws, his nose, the lower part of his abdomen and his ankles. His pains are for the most part "aching" or "rheumatic" in character, and attended by a feeling of tightness, but sometimes he has sharp stabbing pains. He especially describes what he calls "a shuddering pain." These shuddering pains occur in various parts and last only a minute or so, and creep over a considerable area, often in the lower part of the abdominal wall, and often in front of the ankles. His legs frequently become numb when in bed, and he is at all times very sensitive to cold. The soles of his feet often ache or feel very sore, but he does not complain of their being numb, or of feeling as if treading on wool or cork. He can stand pretty well with his eyes closed, and can walk fairly. His right eye is almost perfect, and he slowly reads No. 1 with either, but as I have said he complains that the eyes soon tire.

Some few months ago he felt his legs very numb, then they

gradually became weak, and finally he could not use them at all. He lay in bed at his lodgings several days quite unable to get out of bed. He had no one to attend to him excepting a woman, and as he could not manage to empty his bladder excepting in the erect position, he was obliged to allow his urine to accumulate, and when he was finally carried into St. Thomas's Hospital his bladder was very much distended. This retention had not caused him any great distress. At the hospital a catheter was used, and he believes that "several quarts were drawn off." Thus it will be noticed that we have reason to believe that his bladder is in a state of atony, unable to relieve itself excepting under advantageous hydrostatic conditions.

After he had been in St. Thomas's a few days his legs began to recover, and at the end of twelve days he walked out of the ward. He now went to the Walton Convalescent Home, and there he had a relapse and partially lost the use of his lower extremities again, but not of his bladder. He recovered again, and can now walk a mile or two at a time. On neither occasion did he lose sensation in the skin of his legs, but a feeling of numbness preceded the loss of motor power. As regards treatment, he thinks that he was benefited by the warm bath as much as anything, and believes that he did not on either occasion take the iodide. Several of his medical advisers have at different times questioned him as to his syphilis, and suggested that his symptoms might be due to a taint, but he believes that he has not had the iodide prescribed for many years. A homœopathic told him that his symptoms were probably due to the large quantity of iodide which he took in the first instance. I may add to what I have said that the man shows no local defects either in sensation or motor power. His calves are tolerably large and measure each fourteen inches. His limbs are especially stiff and weak on rising in the morning, and similar results in this respect follow both over-fatigue and sleep. As a rule he sleeps badly and never wakes without a headache. He has never had any drooping of the eyelids or paralysis of the muscles of the eyeball.

Although some of the symptoms commonly met with in loco-motor ataxy are absent, yet I have no doubt that this case belongs to that category. It is true the man can walk with

his eyes shut, and he has not in any conspicuous degree the ataxic gait, but he has the small pupils, the stabbing pains, the attacks of temporary paralysis, and there is the slowly progressive advance of symptoms.

In connection with this case the following is of very considerable interest, since it presents some very similar points, with, however, important differences. It is an example of incomplete ophthalmoplegia interna, and with cystoplegia (partial), and some symptoms of loco-motor ataxy—the whole being possibly due to syphilis.

Alfred D., a fireman, aged 34, married six years, and the father of two children, came to Moorfields on account of failure of sight. His pupils were motionless to light, right No. 6, left No. 2. Both of them contracted on convergence, and in equal degrees. The left had, he said, failed a week ago and had remained the same since; the right had failed still more recently. It is very probable, however, that these dates were not accurate; at any rate they referred alone to failure of the ciliary muscle, the only part of his condition which gave him inconvenience. With + glasses he could see perfectly.

He was a pale man, and had, he said, of late suffered much from leg-weariness. If he walked a short distance he became so tired that he felt as if he could not possibly move his legs any longer, and under these conditions his legs would ache very much. At one time—six months ago—his sexual vigour and desire had both greatly diminished, but recently they had returned. He had of late frequently required the catheter on account of inability to pass water. I examined with a full-sized instrument and found no stricture. There was a history of incomplete syphilis nine years ago. He did not recollect any secondary symptoms.

His vision with R. was $\frac{3}{8}$ and 8 J. near point 13".

" " " L. " $\frac{3}{8}$ and 16 J. " " 18".

In each eye perfect sight for near objects was obtained by a suitable convex glass. It will be seen that the cycloplegia was not complete in either, and was greater in the left than right, yet the left had the smaller pupil.

The next cure which I shall narrate is one of third-nerve

paralysis on left side only, with partial recovery under treatment, but with ophthalmoplegia interna (almost complete) remaining. There was a remote history of syphilis.

Samuel B——, aged 39, was Mr. Tay's patient at Moorfields, February 1878. He had complete syphilis twenty years ago. He married five years later, and has now three children, all healthy; none have died.

Five years ago he had swelling of one testicle, which lasted a long time, and for which incision was advised. It ended, after abscess, in shrinking of the gland, with induration. Probably at this period he took specifics for long.

His eye symptoms began last August, and in the end of that month he was admitted under Mr. Tay's care with double vision. No exact notes were taken, but his left pupil was large, motionless, and "he could not see a letter." The diagnosis then written was "paralysis of left third nerve." His lid drooped, and all the third-nerve recti were affected. On January 17 the left pupil was small and motionless (paralysis of vaso-motor). He could see $\frac{1}{100}$, and with $+ 20 \frac{2}{3}$, and with $+ 7$ read 1 Jäger (hypermetropia and cycloplegia). The pupil was almost motionless, but could be made to act a little on focal illumination. This was after three months' treatment, with 5-grain doses of iodide of potassium. Before the treatment he had suffered a good deal from headache, and pain at back of eyes. The recti muscles and the levator palpebræ had now recovered, and he had no double vision, excepting now and then in looking upwards. Improvement began a month after commencing the iodide. He is liable to some rheumatic pain, but has no stabbing pain.

He does not consider that his right eye has ever ailed anything.

On February 26 I examined him carefully. In full light his pupils are equal, and of normal size (No. 3 to 4). The left, when shaded, dilates only to the slightest possible extent and does not act in the least when the other eye is excited. The right pupil acts well, and in moderate light is nearly twice as large as the other.

With R. he reads 1, and with L. 14, or by effort 10, or with $+ 7$, 1. Ophthalmoplegia interna (almost complete) seems to

have been left after paralysis of third. It is probable that the third-nerve elements in the ganglion have to some extent recovered, since he has no longer a dilated pupil, and there is some slight action on stimulation by light.

It was very interesting in this man to observe how, when the left pupil (paralysed) was exposed, and the right in a full light was alternately covered and exposed, the left remained quite motionless, and this, although the retina in both eyes was perfect. It thus became very obvious that the break of communication was in the irido-motor nerves. The converse of this is seen when, with one eye totally blind, the nervous apparatus referred to remains perfect. In these, as is well known, the pupil of the blind eye acts vigorously in connection with the retina of the other as an incident-excitor. As I have elsewhere stated, I have found it exceedingly difficult, in cases of iridoplegia with syphilitic history, to produce any improvement under specific treatment, whilst, as is well known, the cases of paralysis of the external ocular muscles almost always recover quickly. This case exemplifies this point, for the patient under the iodide got quite rid of his ptosis and strabismus, whilst his iris remained motionless as before. I wish also to draw attention to the fact that, although ophthalmoplegia interna, when uncomplicated by other paralysis, is usually symmetrical, yet that, when associated with third-nerve paralysis, it is often not so. I may add in anticipation that, when third-nerve paralysis is symmetrical, it is not usually accompanied by ophthalmoplegia interna. These statements require the confirmation of further experience, but they are very suggestive and well worth keeping in mind.

I have recently had an opportunity of testing the state of the pupil in a case in which the eye was totally blind after rupture of the optic nerve. A railway porter had a thin ash-stick thrust violently into the nasal side of his left orbit, and never had any perception of light afterwards. There was a large wound, and the eyeball was everted. A month later the optic disc was pale, and perhaps a little hazy, the pupil being quite motionless on exposure. Five months later I examined the activity of the pupil carefully. There was not the slightest action when, whilst the other was covered, it was

exposed to light. When both were open, it maintained nearly the same size as the other, and acted with it most readily. So far as I could tell, it maintained under all conditions the same size as the other. If the other was covered and he were told to converge, or to imagine himself looking at a near object, it contracted at once. The efficiency of the one retina in constituting an incident-excitor path for the stimulation of the internal motor apparatus of its fellow was most conclusively shown.

The following case illustrates what I have said above as to the more symmetrical development of ophthalmoplegia interna in association with paralysis of the trunk of the third nerve. It differs from what is more usual in that there was no history of syphilis, but the negative in this respect must not be considered as certain. It is possible that the eye symptoms are premonitory of ataxia.

Mrs. T., a widow aged 50, is the subject of paralysis of the right third nerve, and with it of the vaso-motor filaments to the iris also. Thus the pupil, instead of being dilated, as it should be with defect of the third, is of natural size, but quite motionless. We will investigate her case in reference to the probable cause. She entirely denied all history of syphilis, and said that her husband was steady, and that her children are healthy. She added that she had always feared that she should have paralysis, as her father died of it (set. 67), and also two of his brothers. Her earliest symptom was aching in the bones of her legs after exertion. This was about two years ago. She was obliged to give up charring-work because she could not go upstairs from the weakness and pain in her legs. Next she had twitchings in the right leg or thigh, and subsequently occasional numbness and tingling in her hands. She complained much of joint-aches in the hands, and mentions twitchings in the muscles of the upper arms. These twitchings are not painful. About a year ago she began to experience attacks which lasted a few seconds, during which she thought she should lose her senses. She never fell or became unconscious, and usually the feeling would after a while pass completely off. About three months ago she began to find that her right eyelid drooped, especially after sleep, and that she

saw double. This was especially the case if she rose in the night.

Two months ago she had very severe pain in right side of head, so that she could not sleep. This has left her. She walks fairly. Sleeps too heavily.

I cannot state anything as regards the results of treatment.

(To be concluded.)

ON A PROLONGED FIRST STAGE OF TABES
DORSALIS: AMAUROSIS, LIGHTNING PAINS, RE-
CURRENT HERPES; NO ATAXIA; ABSENCE OF
PATELLAR TENDON REFLEX.

BY THOMAS BUZZARD, M.D.,

Physician to the National Hospital for the Paralysed and Epileptic.

IN a paper published last January ('Berlin. Klin. Wochensch.') Professor C. Westphal has again drawn attention to a symptom of tabes dorsalis, which he has now had the opportunity of observing in a large number of cases, and which may be described as follows:—In health, if a man sits with one leg crossed upon the other, and the ligamentum patellæ be then smartly struck just below the knee cap, there occurs a contraction of the extensor muscles in front of the thigh, and there is consequently a sudden kick upwards of the leg. Dr. Westphal pointed out in 1875 that this, which he calls by the somewhat awkward title of the "knee-" or "leg-phenomenon," was absent in typical cases of tabes dorsalis. In his late communication he gives reasons for thinking that the test may prove very useful in the early stage of tabes, before there is any ataxia. He says that he has seen cases of pains without ataxia or sensory troubles, but with coincidently commencing optic atrophy, and absence of "knee-phenomenon." One very striking example is related. A woman, thirty-six years of age, suffered from pains, "like knives," especially in the left lower extremity, frequent and severe. She had also hyperalgesia of the skin, so that the least contact was painful. Pains came much more rarely in the right leg, and were not to be compared in severity with those in the left. Repeated ex-

amination showed that the knee-phenomenon was absolutely wanting in the left leg, whilst it was present, but not strongly marked, in the right. The patient's gait was not ataxic. No sensory troubles of the left leg appeared objectively, nor was there loss of muscular sense, as tested by closing the eyes. In spite of all this the case was certainly one of tabes, for there was, besides the pains, white atrophy of the optic nerves, inequality of pupils, along with very frequent and scanty urination.

In all the cases of confirmed tabes in which I have used this test since I became acquainted with Dr. Westphal's suggestion, I have found, as he has done, that the knee-phenomenon was absent. The case which I proceed to relate is one which goes to confirm the diagnostic value of the symptom described. It is one of the nature of which there can, I think, be no question; and it is published, not only on account of the support which it lends to Dr. Westphal's valuable suggestion, but also from the extreme interest which attaches to some of its other symptoms. Amongst these are the great prolongation (already, if we include the two years of herpes unaccompanied by pains, seventeen years) of the first stage of tabes—the remarkable recurrence of herpes every few weeks during fourteen years, as well as certain points connected with the slight amount of vision which still remains in the amaurotic eyes.

It was in April 1864, just fourteen years ago, that I first examined A. B., who was then 36 years of age. His complaint was of bad nights, and troubles in his organs of digestion. Incidentally he mentioned to me the state of his sight, which had become greatly impaired. With the right eye he could only discern light from darkness; with his left he could recognise faces, but all outlines were blurred and confused. He had consulted several ophthalmologists on account of his eyes, and they had described his disease, he told me, as atrophy of the optic nerves. For this he had undergone a variety of treatment, including hypodermic injection of strychnia and the application of the constant current, without any effect.

Family history.—His father, who was gouty, died at 61 years of age. His mother, who was then still living, had always

enjoyed excellent health. (She has since died, at 84 years of age.) No history of tubercle or neurosis in the family.

Previous history.—In infancy, so he had been told, he suffered from “inflammation of the bowels” and bronchitis, besides an attack of whooping-cough. All his life he had been subject to take cold easily, and to suffer from bronchial attacks; and there had always been from his childhood a tendency to looseness of the bowels. When twelve years old he had measles badly, from which he recovered after a long illness. After this, for twenty years he enjoyed excellent health. His habits were temperate in all respects; and the mode of his life, a great part of which was spent in the open air, conduced to healthfulness. He had never had syphilis, but had once or twice suffered from gonorrhœa.

In the year 1860 he had an attack of “muscular rheumatism,” which lasted about a fortnight, but only kept him in bed a day or two. There was no fever; his joints did not swell; and he was able to do his work except on one or two days. As the pains in his limbs ceased, the attack was immediately followed by jaundice, from which he suffered for three weeks, and during which he lost two stone in weight. He is quite clear that since this attack he has never been “the same man.” He never got up his health or strength again. A very notable sequela had been insomnia. He would retire to bed between eleven and twelve o’clock, lie anxiously restless till three or four, and then drop off to sleep for four or five hours. Sometimes, on the other hand, he would sleep on first going to bed, but in that case would wake at three or four o’clock, and sleep no more. Altogether, he had rarely more than four or five hours’ sleep at night.

In 1861 he had for the first time an attack of herpes. It was after undergoing great fatigue that he noticed what he took to be a boil on his right buttock, but which really consisted of a crop of vesicles, which burst and formed scabs. During the next two years he had, on four or five occasions, a recurrence of the eruptions in the same situation. There was rarely more than a single group. These attacks were not accompanied by any pain, beyond a little burning at the site of the vesicles. The eruption did not always follow the same

course. There would be a group which appeared to be going on to maturity, when it suddenly became, as he describes it, stagnant and abortive. The vesicles would not burst, but would wither up and disappear in a few days, without any scab being formed. At another time, after apparently aborting, or at least taking no action for twelve or twenty-four hours, they would then, as it were, re-develop and go through the ordinary course.

It was not till 1863, two years after the attacks of herpes had commenced, that they began to be associated with pains. These were at first confined to the right lower extremity; and attacks had been since occurring, when I saw him, at intervals of a month or so. Their character will be particularly described later on.

The account which he gave of the onset of his ocular disturbance is curious. It seemed that in October 1862, after a severe attack of diarrhoea, he suddenly found an imperfection of sight in his right eye. In reading he observed that he failed to see the end of the word at which he was looking; next he found that whilst reading the top line of a page he could not see the second or third line without lowering the eye, so that ere long he had to put his finger on a line, dropping it as he read, and so spell out the words and lines. This condition, as regards his right eye, stretched over a year. In the autumn following he took a holiday, and amused himself by sketching from nature. He found it necessary to paint by the aid of his left eye, shutting out the right by means of a piece of cardboard suspended from his hat. His health, though then improved, was not up to the old standard, sleep being uncertain and digestion imperfect.

In October 1863, exactly one year (almost to a day) after the failure of the right eye, similar symptoms attacked the left. He had been out sketching, the sight of the left eye being perfect, and went home and dined. In the night he was attacked with diarrhoea, which recurred in the morning. Next day he found that he could not see the ends of words with his left eye, and, as with the right eye, so the sight of the left gradually deteriorated, and was diminishing at the time when he first came to me.

Examination showed the heart, lungs, and liver to present no sign of disease. The urine, which was slightly acid, deposited much urate of ammonia; it contained neither albumen nor sugar, and showed no excess of phosphates.

A. B. remained under my observation at this period (1864) for three or four months. During this time the symptom of which, next to the insomnia, he most complained was the very frequent occurrence of nocturnal emissions. These would happen sometimes four or five nights together, recurring after an interval of a few nights, and repeated altogether from ten to fifteen times in a month. He had always since puberty been troubled a good deal in this respect, but the discomfort had rather increased than diminished. The discharges were involuntary, and were not followed by any feeling of exhaustion.

Meantime the pains which had begun in 1863 continued to recur at short intervals. In 1867 my attention was particularly directed (as I find by my notes) to the pains, and also to the herpetic symptoms from which he suffered, and which he informed me were a repetition of what had occurred on various occasions during the preceding six years. One such attack occurred in December. He woke up in the night with terrible pain in the right sciatic nerve, which he described as "knife-like spasm." It persisted, occurring at intervals of a few minutes only, all the following day. This kind of pain, he said, had been liable to attack one or other of his lower extremities—and especially the right—in the thigh, knee, leg, or ankle. It would generally last a week, and was always associated more or less with an eruption of herpes. The pain usually came simultaneously with, or preceded, the herpes by a few hours, but on the other hand it sometimes, although less frequently, followed the appearance of the eruption. The pain might be in various parts; the herpes *always came in one place*. It always occupied the upper part of the right buttock. Even when, *e.g.*, the pain attacked the *left* lower extremity, the herpes came in the right buttock. He calculated that during the preceding four years he must have had at least fifty or sixty of such attacks of herpes. A "good healthy crop," as he described it, would take from ten to fourteen days ere it

subsided. The pains generally continued throughout, and ceased about the time that the scabs were scaling off. On a very rough average he would have such attacks once in four or six weeks. It appeared that between twenty-four and thirty years of age he used to be affected very frequently indeed with herpes præputialis, which occupied sometimes the prepuce, at others the base of the penis and scrotum.

For fifteen years this patient has suffered every few weeks (with a certain exception) from attacks of pains which he describes as "forked lightning." The seizures were closer together and more violent in character from the end of 1872 to the middle of 1874. During this period of about eighteen months he would have a bad recurrence every two or three weeks.

I have notes of one such attack which I may transcribe.

"1873, *Feb.* 14.—Pains which were formerly rare come now very frequently, and with tremendous force. The stomach seems, to him, to be the directly exciting cause. The pains always affect now the left leg; formerly the right was alone subject. He shows a point two or three inches above the left knee, which has been an especially frequent seat of pain. Over a space not bigger than a crown-piece it is as though some one was giving him repeated violent digs with a knife. The present bout came on yesterday at 5 P.M., and has never ceased for more than two minutes at a time. He knows from experience (and the event proved that he was right) that this bout will go on for four or five days, gradually getting less and less acute, and with longer intervals, until he ceases to suffer. And he will be pretty sure to have herpes. Sometimes the herpes appears first. He will have a patch of heat and itching on the buttock, and then he gets a "fine crop" of herpes. Sometimes the vesicles are abortive, and do not come to the breaking stage. Then the pain does not come so rapidly. The herpes is always confined to the *right* gluteal region, and never passes to the left of the spinal column. I can see now some scars of recent attacks

"The part where the pain first begins, always remains as it were the camp or head-quarters of it—pains radiating from it .

as a sort of focus. So to-day he has had occasionally pains in the left shin and calf, but the left heel, where the pain commenced, has continued to be its principal seat."

From the middle of 1874 till August 1876, he enjoyed almost complete immunity from these attacks. There would be, it is true, at rare intervals a little herpes, accompanied by a faint reminder of his pains, which he graphically describes as "sheet lightning," in comparison with their ordinary forked-lightning character.

Present State.—As regards the relation of herpes to pain, he says that perhaps once in six times the eruption would occur without any pain whatever, or, at the most, with a very little "sheet lightning." Very rarely indeed has he had pains without any herpes, although the eruption has been sometimes so insignificant that it would have escaped notice but for his long experience of it. As a rule, there would only be one crop of herpes, but occasionally a second crop would appear near to the first. In the years of only moderate severity the intervals of attacks of pain would be from six weeks to two months or so. Since they recurred severely in August 1876, they have continued to trouble him at about this rate.

I have lately (June 10) taken the opportunity of examining carefully an eruption of the kind. About two inches above, and to the left of the sulcus between the nates, very near therefore to the sacro-iliac synchondrosis of the left side, I found a single group of seven or eight vesicles of about the size of a large pin's head—some larger, some smaller. They were collected (almost all touching each other) upon a base the size of a threepenny piece, the skin of which was slightly pink in colour, and when pinched up felt hard, as compared with the adjacent integument. The vesicles contained transparent and colourless fluid. This group had appeared two days previously. At the same time I observed one or two brown scabs (the remains of vesicles) on the upper and inner part of the left thigh, where the scrotum rests upon it. On the following day the base was less hard, and paler in colour, the vesicles flattened and shrivelling.

It is only since 1873 that herpes has appeared to the left of the spine. Before that time it always came upon the right

buttock. Since then, however, it has been, if anything, a little more frequent on the left buttock than on the right, and most frequent of all, perhaps, about the middle of the sacrum and the sulcus of the nates. Herpes has never shown itself on both sides at once.

It is to be noted that his pains do not appear, at least commonly, to originate in the buttocks, which, however, are the constant seat of the herpetic eruption. Occasionally, it is true, the pain will seize him in either groin, and then shoot round over the hip to the buttock; but these are much less frequent sites of pain than others. He cannot say which is the most frequent site.

The patient has a firm conviction that all his attacks of pain and herpes are associated more or less with intestinal disturbance. If he feels that he has eaten too much at dinner, he is apprehensive of an attack, and is pretty sure to have a "quiver," or flash or two of "sheet lightning." Then if there be, as is sometimes the case, a violent discharge of flatus downwards, he knows he is safe. But if this does not happen, the expected attack comes on. Even if a bad attack of pain has started, should there be an escape of flatulence he will often get relieved of pain in ten minutes. During bad attacks there are constant recurrences of a pressing desire to pass flatus by the bowel, but the passage does not take place. He does not associate the attacks with the use of any particular kind of food, nor does weather seem to influence them.

Fatigue appears to induce attacks, and, as he thinks, in the following manner. Overtired, he sits down without appetite, which comes, however, as he eats, and then, perhaps, he exceeds a little in the quantity of food taken. Under these circumstances an attack is pretty sure to follow. If, however, he is hungry, and after eating a moderate meal is quiet for two or three hours, he either escapes altogether or there may possibly be a flash of "sheet lightning," which does not go on to the "forked" variety. The last attack began in the night, after taking a small glass of stout at bedtime. At times, when his pains are very bad, there is a

sense of weight in the lower bowel, and a feeling as though something wanted to come away and could not.

Vision: Right eye.—At the present time he can see two window-lights as two, but there is no evidence of sashes. Very thick black hands on a white-faced watch are quite indistinguishable.

Left eye.—He can see the angle formed by the black hands of his watch, and thus get an approximation to the hour. He cannot in the slightest degree recognise any one by sight, nor can he walk about without a companion to lead him.

There is a point of interest as regards colour. The colour blue, he tells me, is not seen as such by him, but as bright light. A piece of bright blue ribbon looks like a bit of burning magnesium wire. If he is walking under a bright sun upon yellow gravel, the shadow which he casts (and which under such conditions is of course very blue in tone) is actually felt by him as something lighter than the sunlit gravel upon which he treads. And so also the shadows of trees, at a little distance, came out quite light from, as he supposes, the influence of the blue in their composition. In photography, he reminds me, the colour blue comes out white.

The sight of his eyes has continually, but very slowly, deteriorated since they were first affected. The pupils are of moderate size, and equal. There is no manifest affection of the external muscles of the eyes.

Direct Ophthalmoscopic examination. Right eye.—The optic disc presents a marked change in colour and character. Instead of the normal warm white or pinkish tint with fine striation, it is of a cold, slightly bluish-grey tone, which suggests the idea of its being painted in opaque oil colour. Its surface is flat, dense, and uniform, no signs of any central depression or *lamina cribrosa* being perceptible, and the sclerotic ring appears to be merged into the disc, the outline of which comes out sharp against the rich red of the choroid. There is no marked diminution in the size of the retinal vessels, but they appear as though applied to the disc, and subdividing near its upper and lower border leave the large bulk of the disc free from any trace of a blood-vessel. Both the branches of the artery and the veins are

bordered by a distinct white line on each side for a distance of nearly two disc-lengths from the optic papilla. This white line would measure about one-third of the diameter of the vessel.

Left eye.—The appearances are practically the same, except that there are a few more minute vessels on the disc than are to be found in the right eye.

Organs of locomotion.—A. B. walks without the slightest tendency to stagger, and this even if (as he will sometimes attempt upon a quiet and straight country road) he dispenses with the arm of a companion. His gait is somewhat peculiar, as he rises high upon his toes at each step; but I have no reason to suppose that this “equine action,” as it might be called, perhaps, is not natural to him. His walking power is a good deal diminished; he cannot now manage three or four miles at a stretch without distress.

Tendon reflex.—If he sits with his legs crossed, and the ligamentum patellæ be smartly struck, there is no contraction of the quadriceps extensor muscle, consequently the leg is not jerked up. If the foot be suddenly and forcibly brought into a state of dorsal flexion, and the tendo Achillis struck, there are no rhythmic movements of the foot. This applies to both lower extremities.

Cutaneous sensibility is absolutely normal in all respects throughout his body. Nor is there any affection of the muscular sense. He knows exactly where his legs are, and can direct his feet readily. So also he can make his two forefingers touch at their points with as great precision as any one in health.

Pains in the trunk.—Within the last twelvemonth he had on three occasions experienced what he calls “sheet lightning pains,” inclined now and then to develop into a passing “forked lightning,” in the right side of his chest. A week ago he suffered for twelve hours, at intervals of only two or three minutes, from attacks of forked lightning pains, which invaded the right side of the chest from about the second to the sixth rib, and appeared to go through to the scapula, corresponding apparently with the intercostal nerves. They were not accompanied by any herpes.

General condition.—A. B. is of healthy aspect and fair complexion, his brown hair being but slightly tinged with grey. His disposition is of the happy kind which is, curiously enough, found so often in patients suffering from tabes. There is marked arcus senilis in each eye. His arteries show no signs of thickening. Bladder normal. Bowels regular, and less disposed to diarrhœa than formerly. Tongue clean. He does not suffer from any constrictive feeling in the waist. His digestion has improved, and he has increased in weight during the last four years.

Examination shows the nates fleshy and firm, the skin covering them, and the sacral region generally evincing no sign of anæsthesia. There are a few slight scars of recent attacks of herpes. One may see, perhaps, traces of three or four, but all except the most recent are very faint, and in strong contrast with the marked cicatrix which follows an eruption of ordinary shingles. Of the attacks which took place at periods antecedent to a few months ago, not a vestige remains.

The character of the optic atrophy, and of the pains, leaves the diagnosis of the nature of this case in no doubt. It is evidently one of sclerosis of the posterior columns, although that particular symptom which has caused the name of progressive locomotor ataxia to be given to this class of disorder is as yet absent. On the other hand, it is interesting to note that the test which we owe to Westphal—the absence of reflex contraction of the quadriceps extensor muscle on striking the ligamentum patellæ—here also lends support; if such were needed, to the diagnosis of tabes dorsalis.

The absence of inco-ordination of movement, whilst other symptoms of the disease—notably the flying pains—are well marked, is, I need scarcely say, not at all uncommon in the first stage of tabes; but it is exceedingly rare, so far as I am aware, for the immunity to extend over so long a period as has happened in this instance. Fifteen years have elapsed since the commencement of the characteristic pains, and as yet no sign of muscular ataxia has presented itself. So long a duration of pains, with exemption from locomotor troubles, is

not, however, altogether unexampled. Charcot and Bouchard have published ('Comptes Rendus des Séances de la Société de Biologie,' Année 1866) particulars of a female patient who died of some accidental disorder after having suffered during fifteen years from lightning pains. Up to the time of her death she walked without embarrassment or projection of the legs; she did not strike the ground with the heels, and closure of the eyes did not affect her security in standing or walking. At the autopsy, the only appreciable lesions (except some doubtful traces of meningitis) were found in the posterior columns, and consisted in a multiplication of the nuclei of the neuroglia, with thickening of the meshes of the reticulum, but without concomitant alteration of the nerve-tubes.

For seventeen years A. B. has suffered from attacks of herpes, and according to his own computation the eruption has come out upon him not less than 180 times. Whilst the pains have been principally referred to the periphery of the sciatic nerves, the accompanying herpes has always, it will be noted, occurred on the skin, which is innervated either by the small sciatic or by the posterior branches of those sacral nerves the anterior divisions of which go to form the sciatic plexus. Some of the pains, it is true, have been referred to districts innervated by the anterior crural nerve; but I think I am right in saying that where these have occurred they have not been alone. On the same occasion the district of the sciatic nerves has also participated in the paroxysms. What appears, therefore, at first sight as a great anomaly, viz. the confinement of the herpes to a very small district, the pains meantime ranging over various parts of the lower extremities, is found to be no longer so much so when we remember that the nerves which supply the skin at the part where the herpes was wont to appear, have a common origin with those which are distributed throughout the length of the lower extremities.

The case of Dr. Charcot's which I have quoted goes far, by exclusion, to show that we may look for an explanation of the lightning pains of tabes to the irritative alteration of the posterior columns of the spinal cord. The researches of Bärensprung especially have shown that inflammation of the

spinal ganglia will produce herpes in the district of the corresponding nerve, and it seems not unfair to conclude that an irritative process attacking the nerve-tubes within the cord would be attended with a like result. The concomitance therefore of herpes, in my patient, with paroxysms of pain, would appear capable of explanation by supposing that such a condition of the cord obtains in his case as was found in Dr. Charcot's patient. But it does not appear so easy to explain the occurrence of herpes *alone* for two years before the pains began. So far as it goes, this circumstance would tend to support the theory of a special system of trophic nerves, which it may be imagined were alone influenced until the growth in the neuroglia attained a certain development. Nor does it seem unreasonable to suppose that the herpes præputialis from which this patient began to suffer when he was twenty-four years old may have been really the first outcome of that diseased condition which has since taken so marked a form. Here, however, we are met by the difficulty of accounting for the fact that trophic disturbances of the skin (like herpes and some other eruptions) are, after all, of very exceptional occurrence in tabes. It happens that I have a case of the kind at present under my care in the hospital, but I do not know that I have had one before. The patient is a man affected with typical locomotor ataxia, who has suffered from highly characteristic pains for the last seven years, the longest interval being a few days. On both legs below the knee, and on the anterior aspect, there is a crop of bullæ. At first the skin comes up, so the man describes it, in a small blister, just as though he had been scalded. This breaks, and discloses (as I could see) red flesh, which was very tender, and which he said might go into an ulcer if irritated, but if not irritated would scab and dry up. One of these places had a scab on it, and this had begun, I was informed, a week previously. The whole duration of a bleb would be about fourteen days. The subcutaneous cellular tissue would appear to be inflamed, as the leg is somewhat swollen, and the skin looks as glossy as a chilblain. The patient began to have these spots five or six years ago. They only lasted a few weeks, and then disappeared till three years ago, when he "knocked both his legs

(owing to his greatly disordered gait), and then they broke out again." Then nothing more was seen until five months ago, when they appeared again after blows upon the legs, and have been coming out pretty constantly ever since. The blebs smart, burn, and sometimes itch. During this time he has pains like electric shocks in both legs, centring in the shins "as if in the marrow of the bones." He thinks that he has had as sharp and continuous pains without as with a coincident eruption.

There can be no doubt about the association of gastric disturbance with lightning pains in the case of the patient A. B. I have watched the commencement and progress of an attack on several occasions, and can confirm his account. But whether, as he supposes, the intestinal irritation set up by undigested food provokes the pains, or whether the indigestion and flatulence are not themselves caused by the same condition, whatever it be, which causes a periodical recurrence of pains, I am not enabled to decide, but should incline to the latter view. As is well known, a tendency to frequent action of the bladder as well as of the bowels is common enough in tabes, to say nothing of the occurrence of seminal emissions, which is so often a result of the malady. In the connection between the abdominal plexuses of the sympathetic and the lumbar and sacral nerves, one is disposed to find an explanation of the coincidence of the affection of abdomino-pelvic organs with that of the lower extremities of the body.

ON THE SYMPTOMATOLOGY OF ALCOHOLIC BRAIN DISORDERS.

BY ROBERT LAWSON, M.B.,

Medical Superintendent of the Wonford House Lunatic Hospital, Exeter.

THE large number of cases of insanity which owe their origin, directly or indirectly, to excessive drinking not only makes the observation of such cases, when massed in a large asylum, comparatively easy, but renders it necessary that an accurate knowledge of the varieties and tendencies of this form of brain disease should be arrived at. In the notes which I am about to record I shall not presume to aim at anything like a complete study of the subject, more especially as Dr. Magnan's excellent work on Alcoholism, translated by Dr. Greenfield, has so recently been placed in the hands of the English public. My motive will be to record, in as simple a manner as possible, some casual observations which have been almost thrust upon me while engaged as an assistant medical officer in asylums which have provided shelter and treatment for the insane alcoholic patients of the densely-populated counties of Middlesex and York. For my own convenience I shall speak of cases of alcoholic brain disorder under two heads. The first class of cases will embrace those of which the prominent characteristic is that they show a temporary interference with, and morbid intensification of, brain function. This class will include *delirium tremens* and *mania e potu*, and the classification is, I think, more accurate than would be the case if I were to speak of these disorders as being simply acute; for though they may be acute in the sense of being severe, they are not acute according to the meaning which the term is generally employed to convey—as running a short and definite course.

The presence in the blood and tissues of a poison which it is necessary to eliminate, and the existence of a delirium which multiplies itself as long as the deterioration of nutrition and the instability of the nerve-centres combine to maintain it, constitute a condition which renders precise limitation of the symptoms and course of the disorder impossible. Without any apparent difference in the constitution of a patient, or in the means by which the mania has been induced, the intense furor which sometimes accompanies alcoholic brain disorder may disappear under treatment during the course of a single night, while under precisely the same appreciable conditions the excitement may in another case continue for weeks. In both cases the etiology, the treatment, and the issue may be the same; but the mania is a factor of so versatile and mobile a character that, though the general and ultimate effect of sedative and nutritive treatment may be safely anticipated, the time which will be required for the production of a good result can never be even approximately determined.

Under the second head I shall speak of cases which are characterised anatomically by an essential variation from the normal structure of the contents of the cranial cavity. This group will embrace cases of chronic alcoholic mania not passing into dementia; cases of dementia of which the principal feature is almost absolute loss of memory for recent events; and cases which either verge upon or merge into general paralysis of the insane.

Under the first head I shall at present refer only to the state which bears the most characteristic name—*mania e potu*—inasmuch as simple alcoholic delirium is a disease with which general practitioners are more familiar than specialists in lunacy. When admitted to asylums, patients suffering from *mania e potu* closely resemble each other even in the details of their history, the nature of their excitement, and in the circumstances of their admission. They have generally undergone an initiatory experience in the police court and the strong cell; are not unfrequently brought to the asylum at night, as if a sudden resolution had been arrived at as to the advisability of regarding the patients as the victims of a disease essentially different from an ordinary attack of delirium

tremens. At times the maniac is firmly secured and accompanied by a body of policemen. His suppressed excitement manifests itself in his expression, which varies in the same individual from abject timidity to sudden and violent emotion and aggressive impulsiveness. The infliction of restraint intensifies the mania in more ways than one. By the employment of force the patient is confirmed in his belief that evil is in store for him, and is driven to bay by the feeling of utter helplessness which, as an external reality, combines with the insane timidity alternating with his outbursts of aggressive excitement. His inability to look upon things in a rational manner places him in a position which corresponds with the experience of an animal in inhaling an anæsthetic. In him the humane motive has the appearance of a purely hostile design, and he experiences all the agony which results from the entertainment of vague notions of coming evil. When relieved from restraint the patient's excitement is almost invariably alleviated, and the administration, forcible if necessary, of liquid nourishment and antacid effervescent, with bismuth and opium, is frequently followed, with comparative speed, by refreshing repose. Sometimes, as I have already said, the effect of concentrated liquid nourishment and sedatives is so marked that one administration is sufficient to produce a comparative removal of the excitement, and the patient begins to be sceptical about the hallucinations which he so recently acted upon with avidity and energy. By a continuation of treatment, and by freedom from restraint, he resumes his former calmness of demeanour, and can not unfrequently fix the exact time of his own recovery by being able to employ his memory in going back, step by step, to a particular hour when reminiscence, first becoming difficult, gradually becomes impossible. He cannot remember the incidents of his excitement, and has only a dim recollection of the nature of his delusions and hallucinations. Unfortunately, however, cases so gratifying in their issue are not often met with. The primary effect of sedation is almost always good, but probably in the middle of the night the patient's sleep becomes less sound, peripheral irritations of a somatic or emotional nature thrust themselves upon the consciousness, and the dreamy thoughts which naturally crowd

into the mind 'twixt sleep and waking again arouse delusions and hallucinations. The patient cannot control his terror or analyse his sensations, and he tries to escape from imaginary foes. If in a single room he may attempt, and sometimes with success, to pass through an iron-guarded ventilator, the aperture of which would seem to the inexperienced to be altogether incapable of allowing the passage of a human body. If in a padded room, he knocks himself about in wild confusion; and if in a dormitory, he generally makes a sudden dart from bed, and rushes wildly forwards in search of some place of safety. But even in such a case the prognosis is rarely unfavourable, and after several sudden outbursts of excitement the maniac—strengthened by the regular administration of digestible and highly-nourishing food, relieved by elimination from the irritating effects of alcohol on the nervous tissues, and soothed by kindly treatment and by such remedies as opium or digitalis—usually regains the use of his reason without showing the slightest trace of dementia; and, after a period of convalescence, is discharged recovered—to resume his ordinary employment, and unfortunately, in too many cases, to resume also the indulgence which compelled him to pass through so trying an ordeal. Though it is evident that in such cases Nature herself performs the greater part of the cure, yet there can be little doubt that some benefit can be obtained by judicious modifications of diet and by the administration of medicines. In the West Riding Asylum I have both in this and other forms of severe mania seen marvellous results produced by the use of a very highly-concentrated essence of fresh meat. This essence is made by placing in a porous covered jar three pounds of fresh meat, free from bone, cut small and without fluid. The jar is placed in the steam-cooking chamber and allowed to remain till the meat is seen to have yielded about a pint of essence. It is salted and simply seasoned with pepper, unless otherwise ordered. With regard to the medical treatment of such cases, I have always placed most reliance on the administration of moderate doses of opium combined with ʒj. or even ʒij. doses of liq. bismuthi. Dr. Magnan, in speaking of such cases as those to which I have just been referring, says, that it is rare in alcoholic mania to have exalted delusions. I

have met only one case of pure mania *e potu* in which there were delusions of exaltation. Dr. Major, of the West Riding Asylum, has kindly permitted me to peruse this case for the purpose of making a few comments upon it. The patient had had several attacks of mania, all occurring during or after bouts of drinking, and the attack which led to his being brought to the asylum seems to have been one of the worst. Before his arrest he had been collecting crowds in the street, making remarks to them about his great ability, and, in gratitude for their patience in listening to him, had been in the habit of supplying them with drink. When taken before the magistrates, he made a witty defence, which occupied about forty minutes. He talked a great deal about his accomplishments, the colleges he had attended, and his numerous dealings with the aristocracy. Both before and after his admission to the asylum his actions and conversation were characterised by considerable wit and humour. In the prison he constructed an effigy of himself, suspended it by the throat from a fastening, and made signs of distress to attract the attention of the warders, who rushed in after he had hidden himself for the purpose of enjoying their consternation at witnessing the apparent suicide of their prisoner. When on the way to the asylum, he asked to be allowed to look at the certificate, intending to secure it, so as to be able to act the part of a relieving-officer and hand over the warder who was conveying him to the asylum. On admission he was very talkative and witty, and tried to get a reputation for knowledge of languages. He spoke in Latin, but when answered in the same tongue was unable to maintain the conversation. He represented himself to have been a captain in the Engineers, and to have bought a public-house for £5000. This patient made a good recovery, and was discharged in about two months.

This is, no doubt, a somewhat uncommon form of alcoholic insanity, inasmuch as in this instance alcoholism seems to have been an exciting cause acting upon a predisposition to well-defined recurrent attacks which were but slightly tinged with the particular influence of the exciting cause. The only delusions of suspicion which he had were against the police-officers who had arrested him. Two points con-

nected with these attacks of mania *e potu* seem worthy of passing notice. The first is, that one frequently meets with cases in which within a comparatively short space of time six or eight, or even more, attacks have occurred in the same individual, from all of which he has recovered without the least trace of consecutive dementia. It appears that if the vessels remain moderately healthy, the mania is due to the actual saturation of the tissues with alcohol, and to the tendency which one series of delusions has to cause the formation of another up to the time when the alcohol has been eliminated, and the excitement subdued by proper nourishment and sedatives. The second point is, that a hereditary and collateral tendency to insanity appears to be more than usually common amongst the victims of mania *e potu*.

In proceeding to speak of the forms of alcoholic insanity in which the presence of some organic change in the cerebral vessels, or the brain substance, is supposed to exist, I have first to mention a form of chronic mania produced by alcoholism, which Dr. Magnan seems to have omitted from his classification. In our English asylums there are numerous cases in which the alcoholic disease manifests itself in the form of recurrent attacks of excitement, generally based upon some delusion of suspicion, or some hallucination of the special senses. Such cases may be of very long duration, and may undergo no change during the greater part of their course. They may commence as uncured cases of mania *e potu*, or they may be the result of a gradually-developing mania arising from the constant abuse of alcoholic stimulants for prolonged periods. That they are characterised by a decided predisposition to insanity is shown by the fact that they sometimes occur in very young patients, in whom the constitutional condition must have favoured the development of the mania. One of the most typical instances I have ever seen was that of a youth, who was about twenty-one years of age, and in whom delusions of suspicion and hallucinations of sight and hearing were developed with great fertility. A leading feature of these cases is that sometimes the patient may be quiescent, tractable, and industrious for a considerable time, unless his delusions are voluntarily or accidentally aroused; but when

they are touched upon, his excitement is extreme. He threatens violence, and seems frequently to be on the point of employing it, but rarely does so. His speech is voluble and vituperative, and his movements agitated and rapid; but he is comparatively coherent, shows no defect of memory, and no other sign of dementia. In rare cases the patient is sullen and intractable, and given to instantaneous outbursts of violence, of which he offers no explanation, and which assume a homicidal or a destructive character. Such a patient is one of the most dangerous of asylum inmates. Cases which manifest the symptoms of chronic alcoholism of the variety under consideration, present a wonderful uniformity in the nature of their delusions. They are essentially delusions of suspicion. The patients imagine that they have been forced to sleep upon damp beds; that poison has been placed in their food; that electricity has been brought to play upon them; that they have been drugged with morphia, dosed with chloroform, or stifled with sulphurous fumes. They are tortured with voices using the most obscene and threatening language, and regard themselves as victims operated upon by hidden agencies, which act with a subtlety greater than that of magnetism or electricity; and though, when their hallucinations are excessively harassing, they are sometimes driven to attempt suicide, yet their mental agitation has little effect upon their bodily nutrition, and they invariably eat well and maintain excellent health.

What is the physiology, so to speak, of these delusions of suspicion? Some consideration of the subject has suggested to me a principle which I think will hold good, and which will suggest the explanation of such delusions in chronic mania from alcoholism. The principle is that in all cases, where the brain tissues, while retaining to a considerable extent their integrity of function, do not receive their proper and sufficient supply of nourishment, delusions of suspicion are apt to occur. Take as a typical case the condition of the mental functions in old age. The advanced senile dement has no delusions of suspicion, but the patient in whom brain-wasting has made less progress, and in whom the physiological tendency to decay is supplemented by privation,

shows marked delusional suspicions. He thinks that his friends are "against him;" that they drug his food, lay plots for the subversion of his interests, or long to be free from the responsibility of his maintenance. The pathological condition in such a case is one which is the result of a physiological diminution of cerebral nutrition. The heart's action fails, the vessels lose their elasticity, the cerebral tissues participate in the general diminution of functional activity, and the diminished *a fronte* combines with the diminished *a tergo* force in reducing the supply of blood. To a certain extent the same pathological condition exists in chronic mania from alcohol. The heart's action is often weak, the abdominal organs often fatty, and the cerebral vessels, especially the smaller branches, are atheromatous, tough, and unyielding. A general tendency to connective tissue degeneration not unfrequently leads to increase of the neuroglia, to the detriment of the proper nerve elements. Similarly, where degraded habits have led to anæmia and cerebral irritability, the same symptoms of mania of suspicion occur; and even in simple cerebral exhaustion—as from overwork—timidity, irritability, and suspicion are apt to show themselves as representatives of the mania which might ensue if proper precautions were not taken. Frequently also in the earliest stages of general paralysis, when alteration of character is first observed, ungrounded suspicions of relatives and friends are manifested. The method of production of these delusions of suspicion seems to be that the modifications in the nature and regularity of the nutrient supply to the brain-cells keep them in a state of excitability—in a condition, so to speak, of dissatisfaction. Now, what are the proverbial effects of hunger, regarded as a general condition? Irritability, excitability, a tendency to put the worst interpretation upon men's motives and actions, and a propensity to hallucinations of the special senses. These very symptoms occurring during sound bodily health are evidently due to the state of the brain-centres as modified by want of food and by reflex excitability. Consequently it is natural that an exaggeration of this condition should result from such a habitual existence of mal-nutrition as accompanies the organic

changes consequent upon the prolonged abuse of alcoholic stimulants.

I have spoken of this condition of chronic alcoholic mania as one which remains almost stationary; but it must be remembered that one condition absolutely necessary for the arrest of the progress of such a disease, is abstinence from the stimulation which induced it. It unfortunately happens that in many cases the first signs of the accession of this mania are not regarded, and the alcoholic, scarcely recognised as being in a critical state, continues his excesses. The pauper patient—usually of comparatively low mental capacity and meagre education—when he begins to manifest symptoms of alcoholic mania, soon develops them to such an extent as to render his recognition as a lunatic imperatively necessary. It is different, however, with the professional man, the artist, the journalist, and the intelligent man of business. The working man's animal propensities usually lie near the surface; his mental operations are less highly specialised than those of the man of refinement; consequently alcoholic changes in cerebral nutrition develop in the latter an initiatory series of symptoms which are not present in the former. How often, for instance, one sees a truly brilliant man undergo a series of painful mental changes directly due to excessive and injudicious indulgence in alcohol. The ready writer, the bright and witty talker, the man of natural æsthetic tendencies with a powerful memory and a gift of ready application has the higher mental faculties in constant operation. He is swayed by changing emotions, and the influence of all forms of excitement, whether emotional, social, or alcoholic, is to intensify, for the time being, the activity of his naturally unstable intellect. When brought into contact with others who manifest the same intellectual tendencies, he has a natural pride in the superiority which secures for him the admiration of persons whose judgment he values; and when exhaustion follows effort, he succeeds in stimulating his weakened powers by alcoholic drinks. For a considerable time, perhaps, while the digestive system remains in such a healthy state as to ensure the supply of proper solid nutriment, this course is pursued with an appearance of success, but soon the urgent symptoms of indul-

gence begin to manifest themselves. The mind, unaided by artificial stimulus, becomes barren and unproductive. Sentences are written that appear to have no point, and jokes are uttered which are destitute of humour. The man who was accustomed to write with speed telling criticisms and pointed epigrammatic sentences, has a consciousness that his mind has become incapable of sustained effort, and that his writing is dull and insipid—a feeling which contrasts strongly and painfully with his previous cheering sense of power and fitness. Under the influence of an alcoholic stimulant, he finds that, for a time at least, he can again command his intellect. But the control is only a temporary one, and is followed by a greater sense of exhaustion than otherwise would have been experienced. Memory, not so much for passing events as for facts, passages, and references, which had been readily acquired, begins to become weakened, and the misery resulting from the loss of a reputation for and consciousness of intellectual power supplies a new incentive to excess. Not unfrequently *petit mal* and attacks of simple vertigo ensue, still showing that the most highly-specialised regions are as yet alone affected. At this stage no one could, as yet, be regarded as insane, though as great a change of function has relatively taken place as leads, in the more lowly-organised mind of the pauper, to the display of delusions of suspicion and hallucinations of the senses. After this, however, if alcoholic indulgence is continued, the ordinary symptoms manifest themselves. Irritability passes into suspicion, voices are heard, illusions experienced, and the mind becoming prone to reverie finds for itself a new and insane sphere of existence. Intellectual helplessness and physical changes advance. One limb may become weak, one pupil may dilate, and, if excessive or even moderate drinking is still indulged in, the victim has no other prospect than to end his days in a state of degraded dementia and muscular paralysis from progressive brain-softening.

There is another well-pronounced class of cases which owe their origin to excess in alcoholic drinks, and which possess some interesting features. In this class the patients are generally advanced in life, are not unfrequently women at the menopause, and generally bring with them a history of

excessive drinking suddenly abandoned. The feature of such cases which is sufficiently striking to give character to them is the almost absolute loss of memory for recent events. The patients are cheerful, attentive, understand what is said to them, and show little dementia as far as simple processes of reasoning are concerned, but are absolutely destitute of memory for passing events. When the medical officer makes his visit (perhaps the third in the course of the day), and asks, "Have you seen me before?" the patient asserts that he or she has not; and the constant ineffectual repetition of this question at short intervals, shows that the capability of retaining new impressions has completely disappeared. I do not mean to assert, however, that all such cases are necessarily of alcoholic causation, but only that they are a frequent result of alcoholic excess. In fact, I think that in cases where organic change has been produced in the brain, the nature of the symptoms will be determined, not so much by the character of the exciting cause, as by the physiological functions of the regions diseased. The same complete failure of memory, for instance, as I have just now commented on, is frequently present in specific disease of the brain; and Dr. Major has drawn my attention to a case in which the exciting cause was the shock produced on the patient by the death of her husband. Though the mention of the circumstance of her husband's death always produced in her the most painful emotions, it was on each occasion accepted by her as a novelty. Each time that the lamentable event was mentioned she regarded the information as something she had never heard before, and the grief she manifested was consistent with this remarkable forgetfulness. Still in other respects she was comparatively rational.

In such cases there are not, as a rule, the other ordinary symptoms of dementia. The patients are not dirty in their habits, sometimes employ themselves, are interested in immediate impressions, but retain no recollection of recent experiences. Such cases seem to begin with comparative suddenness, and may terminate—after a considerable interval, in which loss of memory has been the leading symptom—in apoplexy, epilepsy, hemiplegia (from clot or progressive softening), or in

simple brain-wasting. In such cases there are no paroxysms of excitement, but there is a tendency to general weakness of the muscular system, and a cheerful expression and insane laugh, which, however, cannot be confounded with the look of fatuous rapture which adorns the face of the general paralytic.

The last class of cases of alcoholic etiology to which I shall refer, are those which are frequently difficult to diagnose as distinct from general paralysis. They simulate that disease strongly, and may even merge into it. They occur principally in men somewhat beyond the age commonly assigned as the period at which general paralysis manifests itself. In one respect, also, they are peculiar, inasmuch as the history of the cases generally begins with an attack of what would have been formerly described as brain fever. An attack of cerebritis in a man of 48 or 50, who has been much addicted to alcohol, may leave him in a state of almost absolute dementia and partial paralysis. When he attempts to stand, his knees bend under him. He is degraded in his habits, and eats ravenously. He rarely speaks; but when he does, it is usually to express exalted ideas. His manner may be habitually sullen, or constantly cheerful and fatuous. For a few months his symptoms may show no modification, when suddenly he may burst out into an attack of aggressive excitement. He shows symptoms of a new attack of encephalitis, and, though completely helpless, manifests by his conduct the presence in his mind of delusions and hallucinations. His attempts at violence towards those of whom he knows nothing, and whose motives are humane, show the existence of the former, and his rushing or striking at imaginary objects is sufficient evidence that he is actuated by the influence of the latter. Self-mutilation reveals the existence of some important mental aberration, and I have known one instance in which a patient, strongly alcoholic in his history, and whose case presented such features as I have sketched, lacerated his body with his teeth in a most serious manner. In such cases counter-irritation of the shaven scalp, and the internal administration of digitalis or aconite, sometimes produce wonderfully beneficial effects. After each attack of excitement such patients are seen to lose more and more the use of their limbs. They become more and more

demented, and have recurrent attacks of excitement which close observation ascribes to groundless suspicions and half-expressed hallucinations. They are rarely convulsed, and in this respect, as well as in the nature of their delusions and hallucinations, and in the rapidity of the course of the disorder, they show a decided divergence from the typical course pursued by general paralytics. After death they may be found to have brains presenting no meningeal adhesions, and little frontal wasting, but, on the other hand, showing greater evidences of inflammatory action than those which are found in general paralytic brains. The white matter is often firm and glossy, and tinged with all colours, from a delicate pink to a faint cardinal hue. The cortex is, as a rule, fairly thick and deep in colour. The small vessels are generally tough and coarse, and the large vessels atheromatous.

My object in this paper has been to speak of the features of several well-known and other less-known forms of alcoholic brain disease. I have not referred to alcoholic excess as a cause of general paralysis, except in so far as my last class of cases sometimes contains instances which merge into that disease. I consider that the relation which alcoholism bears to general paralysis is capable of a much more scientific explanation than any which has yet been offered. That explanation will, I believe, come from those who combine a knowledge of microscopy with an appreciation of the most recent views regarding cerebral physiology. I have confined myself to a statement of the symptoms of such cases of alcoholic brain disease as special privileges have afforded me the opportunity of studying, and it seems to me that experience points to the fact that excessive or injudicious indulgence in alcoholic drinks causes cerebral irritation, mal-nutrition, and probably inflammation, which, according to certain special conditions, lead to delirium, delusional mania, chronic excitement with exacerbations, and even to loss of memory, muscular prostration, exhaustion, and death.

THE NEUROSAL AND REFLEX DISORDERS OF THE HEART.¹

BY J. MILNER FOTHERGILL, M.D., M.R.C.P.

It has been stated by more than one writer on the diseases of the heart, that when a patient complains directly of his or her heart in the physician's consulting room, usually no disease is present, but merely a neurosal condition. Probably the only exceptions to this rule are those who have previously learnt from some other medical man that they have some mischief about the heart. My own experience goes to corroborate this expression of opinion. The person who really has heart disease makes complaint of some consequence thereof, as dyspnoea on exertion. Frequently valvular disease is detected by the usual physical examination of patients, and the patient is unaware of anything being amiss with him: in such cases the compensatory muscular growth is sufficient, and is not failing. But when the nervous mechanism of the heart is disturbed, then the patient is acutely conscious that something is wrong, and usually is greatly alarmed and filled with dreads. Perhaps of all patients with neurosal affections of the heart who present themselves to the physician, medical men are the least satisfactory. Unfortunately for their peace of mind, they are but too familiar with the insidious approach of some forms of cardiac disease, and therefore cannot dismiss from their minds their fears and apprehensions as to the interpretation of their symptoms, on the physician's word. Ordinary patients are only too glad to take the physician's word for it that there is

¹ The concluding lecture of a series delivered at the West London Hospital on the Causes and Course of Diseases of the Heart, with Special Reference to Prevention and Treatment.

no disease, and go their way rejoicing—for it is a characteristic of humanity that it readily believes what it wishes to believe. But the unfortunate-doctor himself is not so easily satisfied, and thinks the matter over and over by the light of possibilities, until all comfort is gone, and he has worked all his dreads and doubts into full action again. The consequence is, he is little or no better for the consultation, and the physician achieves no credit. Such, at least, has been too much my experience; though not invariably the case.

The circulation is closely linked with the emotions, not only the heart but the peripheral vessels with their large muscular walls. In joyous emotion we find the peripheral vessels dilated, the extremities warm, and the heart beating vigorously. On the other hand, dread and anxiety contract the arterioles, the face is pallid and the hands are chill, the blood-pressure in the arteries is heightened and the renal secretion is profuse. This is well marked in candidates for examination, whose frequent retirement has given rise to a peculiar expression, which, however, cannot be mentioned here. The same condition is found in hysterical attacks, which usually are followed by a copious discharge of urine of low specific gravity. These effects of emotion upon the circulation have not escaped the attention of poets and novelists, and Charlotte Brontë, in 'Jane Eyre,' makes Mr. Rochester feel Jane's pulse when he wishes to assure himself that she will not flinch or turn sick at the sight of blood. "'Just give me your hand,' he said, 'it will not do to risk a fainting fit.' I put my fingers into his. 'Warm and steady,' was the remark." There was no palsying terror there—the circulation was free and unconstrained.

The blush is an emotional disturbance of the peripheral area of the vascular system, and the Germans term it "Schamroth." It extends over the whole cutaneous area, and is not merely confined to the face and neck, though of course it is seen there chiefly. Dieffenbach was once examining a tumour on the pudenda of a lady, when she blushed, and this blush extended over the nates and thighs of the patient. Palpitation often accompanies the blush, because the dilatation of the arterioles suddenly lowers the blood-pressure in the arteries, and the ventricle having less obstruction to overcome, strikes the chest

walls violently; the more, too, that the emotional state probably also affects the cardiac ganglia. Some persons possess a power of voluntary control over these emotional disturbances of their vascular system, which is called coolness. This is well shown in the steady hand of the practised rifle shot, where a bounding pulse would disturb the aim; and in the coquette who has subordinated the natural tendency to blush to the control of her will. This power of controlling the pulse is effectively utilized by writers. Thus Sir Walter Scott, in the 'Talisman,' makes Saladheen visit Richard Cœur de Lion when wounded, assuming the disguise of an Arabian physician. Before taking the draught offered, the king takes the Saracen's hand, and feels his pulse: "His blood beats calm as an infant's," said the king; "so throb not theirs who poison princes." Similar expressions are to be found elsewhere, even in the pages of Boccaccio. This power of voluntary control over the circulation exists in some persons to a very marked extent, even to the arrest of the heart's action. The well-known case of Colonel Townsend has often been alluded to by different writers. He possessed the power of arresting the action of his heart, and at last killed himself by an exhibition of it. A well-known physiologist in England has also great power in this respect, but he is chary of exercising it. Disturbance of the rhythm of the heart is one of the outcomes of cerebral disease, and is of bad prognostic omen. It is found in hydrocephalus, in compression of the brain, and in inflammation of the brain (Marshall Hall). A curious instance of disturbance of the rhythm of the heart due to cerebral causes came under my care lately in the person of a medical student. He was a tall and stalwart fellow, of good family history and excellent physique, but whose heart had acquired the trick of beating unrhythmically. When examining him one day with my ear on the stethoscope, I asked him a question which caused him to think a moment. At once the rhythm was distinctly changed and the action was slowed, and there were intermissions. In after-visits I repeated the experiment with uniform results. If the question put involved no thought, the heart's action remained unaffected. If it entailed thought, then cardiac irregularity was produced.

Disturbance of the heart's rhythm may also be induced by pressure on the vagus nerve. The famous Czermak, of Prague, had a tumour in the neck lying over the vagus. By pressing this tumour on the nerve, the heart's action could be slowed, or even arrested. Romberg, in his famous work on Diseases of the Nervous System, relates a remarkable case which occurred in Professor Heine's wards in Vienna, of a long ventricular halt from a tumour involving the vagus. "There was an intermission of five or six beats of the heart and the pulse. The aspect of the patient showed that at the time something terrible was going on within him; he sat there as if thunderstruck (attonitus), speechless, motionless: his eyes wide open, his consciousness unimpaired" (vol. ii. p. 340).

Of the neurosal maladies of the heart, angina is one. We know little of neurosal angina, except that it is found very commonly in women at the change of life. It may be a very terrible affection, and yet pass away and leave no trace behind it. It must be discriminated from the true angina pectoris which is caused by spasm of the peripheral arterioles, which raises the blood-pressure in the arteries, and so embarrasses the heart. Transient attacks of this true angina often cause great suffering, but as long as the heart walls are sound there is no great danger; but when the muscular walls are undermined by fatty degeneration, sudden death is a common result. This true angina is most frequently seen in men of gouty history, and is relieved by the administration of potash, and an abstinence from albuminoid foods. Neurosal angina is more influenced by arsenic, perhaps, than any other remedial agent. I have seen recurring attacks of true angina in comparatively young men whose fathers died of angina. They yielded readily to treatment: and yet these men may ultimately die in the same way as their fathers did.

The ordinary neurosal disturbances of the heart are (1) palpitation, (2) irregularity, and (3) intermittency—putting them in their order of gravity; for, though intermittency is a disturbance of the nervous mechanism of the heart, it usually occurs under circumstances which lend it great gravity. Palpitation is excited action of the heart; and may vary from the temporary disturbance caused by emotion or excitement in

perfectly healthy persons, to a persisting condition of the most annoying character. With some persons the heart's action is so disturbing that it causes them great discomfort, interfering with their work, preventing them from falling off asleep, or waking them suddenly and alarming them: Such a heart might be designated "a badly-behaved heart," for its behaviour is very bad indeed. These hearts are very intractable, and are not readily influenced by treatment. Among the out-patients of this hospital are two, mother and daughter, possessing this form of heart. The mother has become practically cured by a long course of quinine with hydrobromic acid; but the daughter's case is much less satisfactory. In both there is a highly-developed nervous system. In another case, a Jewess, at the Victoria Park Chest Hospital, the heart's action was very tumultuous. Being anæmic, she was treated with bromide of potassium and iron. After several weeks, during which no relief was afforded, suddenly the case took a turn, and great improvement set in, her heart once more beating like other people's hearts. In these cases it would seem that the heart is swung in an unusually delicate nerve balance, so that its action is perturbed by slight causes which do not affect other people. Just as there are persons whose stomachs are easily deranged, others where the liver is readily disturbed; so there are those whose brains are quickly upset, and those whose hearts beat excitedly from very slight causes.

Palpitation is a phenomenon about which it is very desirable to have clear and perspicuous views; and in order to attain to this, it becomes necessary to be familiar with the circumstances under which it arises. It may be neurolal, or it may be due to muscular embarrassment; and for its successful treatment it is essential to be accurate as to its causation. It will be well to take the muscular form first, and get rid of it. It was stated in the second lecture that hypertrophy of the heart was due to increased internal pressure within the heart. We know that when blood is experimentally forced into the heart under abnormal pressure that more rapid and more powerful ventricular contractions ensue, and that too when the vagi are cut. Further, when a motor nerve is irritated, the blood-vessels of the muscles, set in action, are dilated, and so a

fuller supply of arterial blood is furnished to the parts that are functionally active. Consequently increased internal pressure within the heart leads to hypertrophy in well-nourished persons. When the hypertrophy is insufficient, palpitation is common. When the chambers of the heart are unduly distended, its sensory nerve is thrown into action. Not only are more powerful and rapid ventricular contractions set up by the discharges of the cardiac ganglia, under these circumstances, but this sensory nerve is also the vaso-inhibitory nerve dilating the peripheral vessels (Rutherford). Such dilatation of the terminal vessels allows the blood to escape easily out of the arteries, and so lessens the amount of obstruction the left ventricle has to overcome on its systole. Without this last arrangement, palpitation would be the usual outcome of effort. Palpitation, or a condition closely allied to it, is induced in most persons by rapidly mounting a flight of stairs, or some similar exertion. By effort the arterial blood-pressure is raised, the heart has more to overcome, and so the internal pressure in it is increased. An aortic cusp is not unfrequently torn down by violent effort. In hearts which are dilated or the subject of valvular disease, effort readily produces palpitation, which is here an active indication of debility. The effect of an altered arterial tension upon palpitation is well shown by the following case:—An old patient, a Westmoreland peasant, with long-standing mitral disease, wrote me lately to this effect: "I have frequent attacks of palpitation, followed by a feeling of suffocation, continuing from ten minutes to half an hour; they then pass off, leaving nothing disagreeable. I am suffering from a cold I got three weeks ago, and, what is most singular, I never have palpitation when in that state." This is a most suggestive statement. In persons with atheromatous arteries and hypertrophied hearts, the subject of chronic Bright's disease, the ordinary square-headed pulse tracing is altered by a cold, a pyrexia, into the pointed tracing of a febrile condition. The change is exactly like that worked in the circulation of such persons by the inhalation of nitrite of amyl—an interesting experiment, showing at once how profoundly the circulation is modified by dilatation of the peripheral vessels. So in this man, with a

heart crippled by valvular disease, he often has palpitation. But when the blood-pressure in the arteries is lowered by the effects of a cold, the heart can easily overcome any obstruction then offered, and there is no palpitation. This fact throws great light upon the causation of palpitation, by effort, and explains how palpitation is readily induced when the heart is weak.

In the subjects of gout, or lithiasis, there is a condition of high blood-pressure in the arteries caused by contraction of the peripheral arterioles. When the blood is abnormally impure there is often arteriole spasm, causing a sudden further rise in the blood-pressure in the arteries and embarrassment of the heart. This is the pathology of true angina pectoris. More commonly, however, the cardiac embarrassment is manifested by an attack of palpitation. Probably in each case the attack is relieved by the action of the sensory nerve, just alluded to, which dilates the peripheral vessels and relieves the heart. In such palpitation it is well to follow this natural method of relief, and to dilate the peripheral vessels by nitrite of amyl.¹ Having cleared away these two forms of palpitation, we may consider the truly neurosal forms.

Neurosals palpitation of the heart may be primary or reflex. The reflex forms of palpitation are very common. They are often due to uterine disturbance, and still more frequently to ovarian trouble; but they may be produced by some condition of the stomach or of the intestinal canal. Thus prolapsus of the womb will frequently set up severe palpitation, relieved at once by the replacement of the womb. So ovarian congestion will cause palpitation, and other neurosal disturbances. We know that, if a number of ivory balls be hung in a row and the end one struck, it is the ball at the other end which flies from its place. So in nerve disturbances the perturbation is not felt where it commences, but where it runs out. The localised spots of pain connected with visceral derangement are well known. In liver derangement, pain is often felt in the terminal cutaneous twigs of the acromial nerve at the

¹ This form of palpitation is more common* with women than men, as in chronic Bright's disease men usually have cardiac hypertrophy, while in women the hypertrophy is commonly blended with dilatation.

point of the right shoulder, or in a twig of the sub-scapular nerve under the right shoulder-blade. So in ovarian disturbance waves of nerve perturbation are set up which traverse various nerve fibrils, and cause different results according to the route pursued and the track taken. If the wave passes to the stomach, we have dyspepsia (see an article on Ovarian Dyspepsia, 'American Obstetrical Journal,' Jan. 1st, 1878); if to the cardiac ganglia, we get palpitation: and both these maladies, to which women are so much more liable than men, are commonly reflex, and due to the condition of the ovaries. Or it may travel to the respiratory centre and set up a neurosal cough. At other times it passes out at the cutaneous terminations of the facial nerves, or of the intercostals, especially the sixth and seventh, where it is felt as a gust of neuralgic pain. This is the explanation, in all probability, of the "pain under the heart," so commonly complained of by women. In reflex palpitation of the heart it is essential for successful treatment to bear in mind its causal associations. It is well to put a blister over the ovary, usually the left one, to open the bowels and relieve the ovarian congestion by sulphate of magnesia, and then to deaden the conductivity of the nerve-tracts by full doses of bromide of potassium. By such a line of treatment excellent results can be attained in a very troublesome class of cases.

The heart was regarded by the older physiologists as the seat of the emotions, and it is certainly in intimate relation with the reproductive organs. In some women the sexual act excites such palpitation that their marital relations have to be completely suspended. The same is found to a less extent in men. Disturbed cardiac action is often so associated. Depression of the vascular system is often a cause of malaise and a feeling of "not feeling well," so frequently found in persons living under favourable circumstances; as country clergymen, for instance. In my experience this is rather the case with married than single clergymen; and on accurate analysis it will be found that it is not the discharge of their social, nor yet of their parochial, but rather of their spousal duties that is telling on them. This cause of cardiac disturbance is one

familiar only to practitioners of some experience, and is a very delicate subject to deal with.

Then we must admit that there is a form of palpitation which is truly neurosal, a neurosis of the cardiac ganglia, just as whooping-cough is a neurosis of the respiratory centre. It is usually found in girls, and consists of paroxysms of violent action of the heart, when the pulse is comparatively quiet. As to its presence in cases of chorea and in Graves's disease we can entertain no doubt. As to its mode of production we at present know little. Trousseau denominated Graves's disease a neurosis of the sympathetic, and Niemeyer thought the vaso-motor nerves of the coronary circulation chiefly affected. In chorea and in Graves's disease the action of the heart is sometimes so violent that it seems as if it would shatter off the walls of the chest over it. The treatment of such palpitation is not very satisfactory. In chorea, and in those cases where, as is said before, there is a "badly behaved heart," bromide of potassium is of great service, and may be given alone or with iron. Or quinine and hydrobromic acid may be tried. In all cases it is well to search out and get rid of any source of reflex irritation. Botkin of St. Petersburg (*Maladies du Cœur*) relates a case where excited action in the heart was kept up by a floating kidney. In the treatment of these cases of neurosal palpitation great patience is requisite both for doctor and patient, and each case must be studied separately, and the condition of the circulation generally carefully appraised, for any success to be attained.

In considering the neurosal affections of the heart the question arises, "Are the nervous disorders of the heart on the increase at the present time?" To this question an affirmative answer must be given. Probably the increase is less marked in women than in men; and some forms of palpitation must have existed amidst the spouses of primitive man—long before advancing culture had rendered the nervous system of women so sensitive as we now find it. Still it may be affirmed that the increasing delicacy of the female constitution renders them more liable to neurosal disturbances generally, and with that to cardiac disorder. But in the case of man, the present keen struggle, not for existence merely, but for success is

telling severely on the nervous system. The battle of life is now fought, not by thews and sinews, massive bones and mighty muscles, but by active brains and keen wits. The brunt of life's struggle is now mainly borne by the nervous system, and it suffers accordingly. One overworked man will have cerebral symptoms; another will have a disturbed heart. Want of sleep, anxiety, overwork, are the causes of a great deal of cardiac disturbance now presented to the physician. The symptoms simulate those of a feeble heart, and are often taken, or mistaken for them. They are indeed due to exhaustion of the cardiac centres, and are recovered from by rest and quiet. A form of cardiac disorder hitherto undescribed was carefully delineated by Dr. Da Costa of Philadelphia, after the excitement of the recent American civil war. He denominates it "Irritable Heart." He found it usually amidst men who had been engaged in active service, and who had had either ague or diarrhoea, or something which pulled them down. After a short stay in hospital the patient would rejoin his command, but soon found that he was not equal to his duties as before. He would have attacks of dizziness and palpitation on the march, so that he would have to be invalided. The heart's action would be excited and irregular, the number of beats more per minute on assuming the erect posture was from twenty to forty, the respirations not being proportionately increased, and exertion was badly borne. It did not always occur with conditions of cardiac debility, and in some cases the heart was hypertrophied. (Here trophic changes followed excited nerve discharges—nervous hypertrophy.) According to the associations was the line of treatment to be adopted: where there was debility, digitalis, strychnia, and belladonna were most useful; but with hypertrophy, aconite was the agent most serviceable. Dr. Da Costa observes, the treatment is never a short one, and my experience tells me that that is true of all the neurosal affections of the heart.

The next form of disturbance to be considered is irregularity, a brief pause not extending over a complete cardiac revolution, as is the case in intermittency. Dr. B. W. Richardson describes it thus: "It is like a smith who, striking a forge in

rhythmical succession until tired, changes the action for a moment to give a more deliberate and determinate blow, and then rings on again in regular time." To me it has always seemed to resemble the change in a horse's feet when cantering: tiring of leading with one foot, it suddenly changes and leads with the other foot for a time, then changes again. Sometimes the beat after the brief pause is stronger than usual, as if the longer the discharge of the cardiac ganglia had been kept back the more powerful it became. This irregularity is commonly found with cardiac dilatation, and the apparent "roll over" of the heart is most characteristic, and once experienced never forgotten. If the irregularity occur at distant intervals and is not influenced by exertion, then it is of no significance. But if, on the other hand, it is increased in frequency by effort, then its diagnostic and prognostic value is very different. It is very frequently found with dilated hearts and with mitral disease. It may be a mere nervous phenomenon, or its import may be grave: its importance depends upon its surroundings. In reference to irregularity, George Balfour quotes the lines of Ballatyne,

"My vera heart gaes loup, loup,
Fifty times a day ;"

and this describes well the condition of an anxious mother with a feeble heart.

Intermittency is a halt extending over a whole cardiac revolution. B. W. Richardson says that the auricular contraction fails to set up the subsequent ventricular contraction which normally follows, and a second auricular contraction is required to start the ventricle off. Experimentation on rats some time ago enabled me to corroborate this statement, and as the animals died even more than one extra-auricular contraction was required to start off the ventricle which paused over three, or even four, auricular contractions. When the ventricle, however, did contract, its contraction was a continuous movement of the auricular contraction. So much for its mechanism; but what is its significance? That varies with its concomitants. To B. W. Richardson are we indebted for the demonstration that it may be a nervous phenomenon of

little or even no significance. He found it follow terror during shipwreck and to disappear in time. In another it was induced by grief, and occurred twenty-three times in the minute, but fell under treatment to twice only in one hundred and sixty beats. In a third case it was brought on by passion. From two cases recorded by him it would appear that it may be to some extent hereditary; while he found it once in an infant at birth, persisting till the fifth year; and once detected it in a marked form in a dog. Now, Dr. Richardson is quite right in insisting that it is a nervous phenomenon, and that it is due to an arrested discharge of the cardiac ganglia; but nevertheless it is commonly found under circumstances which lend it gravity. Where the intermittent halt occurs at rhythmic intervals, it is usually neurosal only; but if it occurs at irregular intervals, and more especially if it be increased by exertion, it is significant of organic changes going on in the structures of the heart, usually of a degenerative character. Intermissions in the heart's action are very common in the moribund condition, when the ventricle pauses over one or more auricular contractions.

Whenever the halt is so long that the blood-pressure on the brain is lowered, then the patient suffers acutely. Two such cases I have seen where the halt lasted over four ordinary cardiac revolutions, and the patients' features told of the horrible sensations which were going on within them, reminding me forcibly of the account given of Heine's patient. Dr. Richardson says, "The man or woman with a hesitating heart is thereby unfitted for sudden tasks, demands, resolves, which, when the heart is firm, are considered comparatively of little moment: for when the heart hesitates, the brain, which reposes for its power on the blood the heart supplies to it, falters with the heart, just as the gas flickers when the steady pressure is taken off the main." It is this matter of imperfect blood-supply, especially to the brain, which makes intermittency of the heart's action serious, or not, as regards its effects. This halt of the ventricle over a complete cardiac revolution must be distinguished from that form not uncommon with aged persons, where the intermission is due to a ventricular contraction too feeble to affect the radial pulse. Here,

on examination with the stethoscope, it will be found that the cardiac contractions are regular and rhythmical, but that they vary in power: the bulk reach the radial pulse, but others fail to do so; so that there is an intermittent radial pulse without true cardiac intermittency. Dr. George Balfour relates a case of an old gouty lady who was attacked with syncope, where he found the radial pulse only twenty in the minute. On examining the heart he found it beating "with perfect regularity, but with unequal force, so that the apparent abnormal slowness of the pulse was simply due to the fact that only about every third beat reached the periphery." Dr. Hayden says, "True intermissions usually occur at short but unequal intervals of time; they are most frequently met with in old persons otherwise apparently healthy, and associated with a weak cardiac impulse, and clear sharp sounds; the arteries are likewise usually tortuous, and often atheromatous: in short, the symptoms and signs of dilated heart and atheromatous degeneration of the arterial system are usually associated with this form of intermission." My experience is quite in unison with that of Dr. Hayden, and intermittency is commonly found along with evidences of muscular failure, and frequently with indications of some fatty degeneration. We saw in a preceding lecture that when the arteries become atheromatous they lose much of their elasticity; and as this change goes on in the aorta, —while the coronary arteries become thickened and their lumen diminished, their tortuous condition breaking the blood-current through them,—the structures of the heart become imperfectly nourished, and degenerative changes ensue. Intermittency of the heart's action is not due to muscular failure, except in the spurious form just described, but to a delay or failure in the rhythmic explosions of the cardiac ganglia. This may be due, as in Heine's case; to some irritation in the vagus, but in the very great majority of cases it is due to some change in the cardiac ganglia. They, like the muscular structure of the heart, may be imperfectly nourished, and so discharge unrhythmically. So far as I am aware no examination has yet been made of the condition of the cardiac ganglia in cases of fatty degeneration of the muscular walls, and a comparison of such ganglia with those from perfectly normal

hearts; but it is a matter well worth investigation. From what has been said of intermittency it is clear its import is derived from its surroundings and associations. In some cases intermittency is found along with palpitation, especially in gouty females of middle age. When such an attack comes on at dead of night, it is very alarming, and the complaint made is usually to this effect: "I am not so afraid when the heart is beating loud, for then I know it is going; but when the stoppage comes, I feel as if I were going to die;" and no doubt when the brain falters from an insufficient supply of arterial blood to it, the sensations are very unpleasant, and add to the alarm caused by the apparent stoppage of the heart. Intermittency so associated has occurred in my experience chiefly in women of neurosal diathesis. The treatment of intermittency is the treatment of the condition with which it is associated. When neurosal, it may be treated by tonics and iron; when concurrent with fatty degeneration and waning power in the heart, digitalis may be added; and if it occur in persons decidedly gouty, a little potash with the digitalis will be useful. Under such treatment intermittency will often disappear for a considerable time; but it would be a mistake to think therefrom that any permanent good had been achieved. The evidences of failing power will again show themselves in time.

Closely allied to intermittency is the very slow pulse of some persons, and even of some families. Such a case was sent me some time ago by Mr. Pugin Thornton. It occurred in a young woman, who had disease of her larynx. The heart beat only some twenty times a minute, yet it did not affect her injuriously, and she had no fainting or syncope. Persons with slowly acting hearts are rejected for military service, but on what precise grounds I have not yet been able to ascertain. Some years ago, in Berlin, I was consulted about a young gentleman whose heart beat some forty times per minute, and who was so rejected. He was an active man, given to hunting and other energetic practices, and would no doubt have signalized himself as well on the march as in the boar hunt, had the opportunity been furnished to him. If there are evidences that the system, and especially the brain, is suffering from an

insufficient supply of arterial blood in consequence of the slow action of the heart, then it would be a malady; under ordinary circumstances, it is only a peculiarity. In one family known to the writer all the members of it have a slowly-acting heart; yet they are an active family, and in no way suffer from this leisurely action of their cardiac ganglia.

The explosive discharges of these motor ganglia are affected by temporary conditions of overwork and worry, especially when combined with an insufficiency of sleep; and much cardiac irregularity, with lack of power, is so produced. At other times temporary depression is set up by an attack of diarrhœa or a debauch. Here probably there is some failure in the muscular structures as well as the ganglia. Such cases of sudden failure are not uncommon among mountain climbers, and the guides of the Tyrol are familiar with this state, where the affected person loses all nerve and power, and has to be got down the mountain-side as well as may be. This occurred once to an American friend of mine in Vienna, a man of iron nerve and will ordinarily. More than one such case of cardiac failure on the Righi has come under my notice.

Irregular action of the heart is like a murmur; it is much easier to detect it than to exactly appraise its significance. From this point of view cardiac diseases are not matters to be settled by the stethoscope, though that instrument may furnish valuable information. Serious organic change may be simulated by conditions which are not really grave; and the neurosal and reflex disorders of the heart are matters for the careful consideration of the practitioner.

THE EFFECTS OF SECLUSION ON THE BODY WEIGHT.

BY HENRY CLARKE, F.S.S., L.R.C.P.,

Surgeon to H.M. Prison, Wakefield.

THE effects of seclusion as a remedial agent in the various forms of insanity is a subject on which considerable difference of opinion still exists in the writings of those best able to judge of its results; and it was suggested to me some time ago by Dr. Crichton-Browne that certain facilities existed in a prison for determining with greater accuracy than could be attained in an asylum some at least of the physical effects of this form of treatment. The present note refers to one only of these; namely, the loss or gain in weight. The body weight of prisoners, both as an indication of their physical condition while in gaol, and as showing the normal variations in the nearest approach to a state of "physiological rest" we can probably arrive at, has been already investigated with great minuteness; one of the most important papers on this subject being that published by my predecessor, the late Mr. Milner, while in charge of the convicts at the (then) West Riding Prison.¹ He there shows from an analysis of 4000 cases the influence exerted on the weight by certain conditions he selected for investigation—namely, the season of the year; the period of imprisonment; the employment in prison; the age and height of the prisoners. As it did not fall within the scope of his communication to trace out the effects of the different forms of seclusion for prison punishment, I commenced a number of observations with the view of supplying this

¹ 'Sanitary Review,' January 1859.

deficiency. The county prisons, however, at the beginning of the year passing into the hands of Government, the whole of the conditions as regards diet and punishment for prison offences have been so materially changed as to render it necessary to bring the present series to a premature conclusion. I should not have thought it worth while to publish the results of the few I had collected before the alterations, were it not for the fact that, under the regulations of the new Prisons Act, the number of days during which a prisoner can be kept in the dark cell has been reduced from three to one, so that the opportunity will not again occur of observing the alteration in the weight caused by the longer period of confinement.

The forms of punishment seclusion investigated were four, commonly known as the dark cell, the half-light cell, solitary, and off association. The following is a brief description of the conditions under which prisoners are placed in each:—

*Dark Cell.*¹—The dark cells have a capacity of a little over 800 cubic feet, are ventilated, and in winter warmed, artificially. They are absolutely dark, and almost, but not quite, sound proof: prisoners placed in adjoining cells can undoubtedly communicate by shouting loudly. The diet consists of 6 ounces of bread for breakfast and supper, and 4 ounces for dinner, with a pint of water for each meal. The prisoners wear the same clothing as at other times, except that their neckerchief, apron, and cap are taken away. They are allowed two rugs at night, and sleep in their clothes on a wooden or plank bed. They are visited five or six times a day by the warders, and by the matron, chaplain, and surgeon, daily. The period of confinement varies from one to three days, and the prisoners are usually in a good state of health, as the surgeon has the power of recommending their removal from punishment, or its non-infliction, if he believes them to be mentally or physically unable to bear it.

*Half-light Cell.*¹—The half-light cells are of two sizes; the smaller have a capacity of about 580, and the larger about 800 cubic feet. In the former, light is admitted through a bull's-eye

¹ As a form of punishment these really come under the head of "Solitary," but for the purposes of the paper it has been thought better to consider them separately.

window; in the latter, through an iron shutter pierced with holes placed in front of the ordinary window. The light is dim, but sufficient to read by. The inmates are allowed a Bible and Prayer-book, and have their bed in at night. The other conditions as regards diet, &c., are the same as in the dark cell.

Solitary.—During solitary confinement the prisoners are kept in their own cells, which vary in different parts of the prison from 800 to 1000 feet in cubic capacity. The bed and bedding are taken out during the day, but given in at night. The prisoners have no work of any kind, but a Bible and Prayer-book are allowed to those who can read. The diet and the clothing are the same as in the dark cell; and the duration of punishment likewise never exceeds three days.

Off Association.—When taken off association, prisoners are simply confined to the ordinary cell for a varying period, not being allowed out either to exercise or chapel. They have the regular work and diet belonging to their particular class or stage. The period of confinement in the cases noted varied from three to fifty-eight days.

The total number of observations was 134, and the results were as follows:—In the dark cell cases the number of observations was nineteen, the average length of time under punishment being 2·5 days. Fifteen prisoners lost weight; two gained; and two remained stationary; the net result being an average loss of 0·85 lb. per prisoner per day. The extremes were a loss of 2·1 lb. and a gain of 0·5 lb. a day. In the half-light cell, a much less frequent form of punishment, there were only seven observations. All the prisoners lost weight, and at the average rate of 1·11 lb. per day. The average length of time under punishment was 2·4 days; and the greatest loss 2·6 lb. a day. Out of seventy-two prisoners who underwent solitary confinement, sixty-six lost weight, three gained, and three remained unchanged. The average length of time under punishment was 1·8 days; and the net result an average loss of 1·27 lb. per day per prisoner; the extremes being a loss of 6 lb. in two days, and a gain of 2 lb. in one day. Thirty-six prisoners were taken off association. Of these sixteen gained weight, sixteen lost, and four were unaffected. The average length of time under punishment was

11.7 days, and the net result an increase of 0.04 lb. per day per prisoner. The average increase of those who gained was 0.22 lb., and the decrease of those who lost 0.19 lb. a day; the extremes being a loss of 0.03 lb. and a gain of 0.6 lb. a day.

It is found, as a rule, that short-timed prisoners are heavier on discharge than on admission. It is difficult, as the conditions are so various, to arrive at the exact amount that must be added to or subtracted from the above figures to allow for this normal variation; but from an examination of many hundred cases it appears that prisoners sentenced to three months and under gain on an average about 0.02 lb. a day, so that the results under the first three heads must be increased, and under the fourth diminished, by this amount, to give the actual gains or losses due to the different forms of seclusion. In the first three cases it makes so small an alteration—the period being so limited—that it may be practically disregarded. In the fourth or off association class, it lessens the apparent daily increase to such an extent as to make it very doubtful whether simple seclusion in a cell for a limited period—say a month or under—exerts any material influence on the body weight. Of course I refer here simply to the weight, as other effects, both physical and mental, not unfrequently arise, which make it very important that these secluded cases should be very closely watched by the medical officer.

It is an interesting question with regard to the solitary cases, whether the loss in weight is due entirely to the lessening of the amount of food, or whether any, and, if so, what, proportion is brought about by any mental or nervous condition, acting either directly and interfering with the due appropriation of the bread taken, or indirectly in causing such a state of anorexia that even the limited diet allowed is not all eaten. That, apart from wilful abstainers, the latter is sometimes the case, is doubtless true; but it mostly occurs with those who have seen but little of prison life, and its rarity is indicated by the fact that in the present series of observations food was refused in only three cases. From these and other facts I have collected, I am inclined to the belief that in the "habitual criminal," as Dr. Nicholson uses the term,¹ the loss in weight

¹ 'Journal of Mental Science,' July 1873.

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is entirely due to the deprivation of food. It is not my purpose to say anything here as to the mental effects of seclusion, but they vary, probably, in intensity in an inverse ratio to the frequency of the punishment. I have seen one hour's confinement in the dark cell, in the case of a young man convicted and punished for the first time, produce such a condition of fear and dread as to necessitate his immediate removal, the whole body being in a state of excessive tremor, and the sweat pouring off his face. With old hands, on the contrary, nothing of this sort is ever seen; in fact, some seem to hail the change rather as a relief from the monotony of their daily lives. I have notes of one incorrigibly idle man who persistently refused, in spite of repeated punishment, to perform his allotted task. He was sentenced to twelve months' imprisonment, and during his term he was punished no less than twenty-eight times, entailing seclusion for seventy-one days on bread and water, forty-eight of these being in solitary confinement, and twenty-three in the dark cell. I watched him carefully the whole time, but was unable to perceive that it had the slightest effect upon his bodily or mental condition; while, with respect to his weight, he left the prison 3 lb. heavier than he came in.

The prisoners were all females, and the observations extended over a period of eighteen months, but I have been unable to find any variation which might be regarded as being due either to the season of the year or to the age of the prisoner.

TABLE OF RESULTS.

FORM OF PUNISHMENT.	No. of Observations.	Average length of time under punishment in days.	No. losing weight.	No. gaining weight.	No. unaffected.	Net result in lbs. per day.	Allowing for normal increase, say 0·02 lb. per day.	Extremes in lbs. per day.	
								Loss.	Gain.
Dark Cell...	19	2·5	15	2	2	-0·85	-0·87	2·1	0·5
Half-light Cell ...	7	2·4	7	..	..	-1·11	-1·13	2·6	..
Solitary ...	72	1·8	66	3	3	-1·27	-1·29	3·0	2·0
Off Association ...	36	11·7	16	16	4	+0·04	+0·02	0·03	0·6

Critical Digests and Notices of Books.

On Infantile Paralysis and some Allied Diseases of the Spinal Cord—their Diagnosis and Treatment. By JULIUS ALTHAUS, M.D., M.R.C.P., Senior Physician to the Hospital for Epilepsy and Paralysis, Regent's Park. 8vo., pp. 56. Longmans & Co., London. 1878.

THIS monograph, to which the silver medal of the Medical Society of London was awarded on the 8th of March last, treats of a subject of considerable scientific and practical importance, with admirable succinctness and perspicuity. It brings into small compass, in a methodical manner, all that is known of the pathology of the anterior grey cornua of the cord; and by the firmness with which it differentiates its subject-matter,—drawing in what appertains to it, and pressing back what is extraneous,—it imparts somewhat of order and intelligibility to regions lying beyond its own immediate domain.

After a brief sketch of the normal and pathological histology of the spinal cord, and of recent experimental investigations into its functions in health and disease, in which justice is done to the labours of Pflüger, Goltz, Boll, Hayem, Liouville, Leyden, and Hamilton, Dr. Althaus proceeds to describe the symptoms of infantile paralysis. This disease may present itself suddenly, as paralysis in a limb or part of a limb of an apparently healthy child, but more frequently it is preceded by general malaise, and is ushered in by high fever, loss of appetite, pain in the head, and fits of eclampsia. After the eclampsia comes the paralysis, which reaches its maximum in a few hours and has no progressive character, and which may affect one or the whole four limbs and the muscles of the back

also. In this paralysis there is no affection of sensibility, which remains perfectly normal; no paralysis of the sphincters, which continue to act properly, and no decubitus. It is exclusively motor in character, and is followed by muscular atrophy, to which is frequently added contraction and deformity. When it is complete the muscles give no response to faradic electricity, the diminution of their excitability, as well as that of the nerves, beginning on the third or fourth day of the palsy, and continuing to increase until the end of the second week, when, as a rule, the excitability has altogether vanished. To voltaic electricity the muscular response gradually diminishes until the end of the first week, when it begins to rise, and ultimately becomes exalted beyond the normal standard. The paralysed muscles will then answer to ten or fifteen pairs of the battery, while the healthy muscles will respond only to twenty-five or thirty pairs. The normal response to the negative and positive pole is also altered, so that the cathode which generally predominates over the anode loses, and the anode gains in influence. At the end of a month there is a decided fall in the galvano-muscular response altogether. Ultimately any degree of voltaic power which it is possible to use produces no effect, or only a very slight one on making with the cathode.

Infantile paralysis is rarely fatal, so that post-mortem examinations have been unfrequent. The microscopical observations however of Cornil, Prevost, Vulpian, Lockart Clarke, Charcot, and others, leave no doubt that infantile paralysis is due to an extremely acute myelitis of moderate intensity, which is either diffuse or occurs in circumscribed areas, and affects more particularly the cervical and lumbar enlargements of the cord, the inflammation being generally confined to the anterior grey matter. In advanced cases the anterior cornua may be seen with the naked eye to be wasted, while their microscopical examination proves that their cells and fibres have been to a great extent replaced by connective tissue and amyloid corpuscles. Any cells that remain are shrunken and disintegrated. The peripheral nerves which have been paralysed are wasted, and the muscles are in a state of degenerative atrophy.

In the anterior myelitis of adults, which is comparatively rare, the symptoms, and their course and grouping, are almost identical with what is seen in infantile paralysis. In two striking cases which Dr. Althaus details, the apparent cause of the disease was a chill when the body was heated; but it seems probable, as he remarks, that there must have been at the moment of invasion a state of diminished resistance of the cord to external unfavourable influences. In the only distinct case of anterior myelitis in the adult which I have encountered, the disease came on in a clerk of sedentary habits, who had fatigued and heated himself inordinately by walking twenty miles on a bank holiday, and who sat for some time on the sill of an open window, on his return home, to cool himself, until, as he phrased it, he was "chilled in his loins." The etiology of this disease, however, as well as of infantile paralysis, is still exceedingly obscure. We can say definitely, however, that it is not of neurotic, syphilitic, or alcoholic origin.

The differential diagnosis of anterior myelitis is comparatively simple. From acute central or transverse myelitis, from hæmorrhage into the spinal cord, from spinal hemiplegia or hemiparaplegia, it is distinguished by the absence of anæsthesia, paralysis of the sphincters and decubitus, which characterises it. From progressive muscular atrophy it is marked off by the fact that the wasting of the muscular tissue in it does not precede the paralysis. From cerebral hemiplegia it is separated by the different commencement of the paralysis, by the non-involvement of the cerebral nerves, and by the loss of the farado-muscular excitability. With the palsy of obstetric operations, and with sclerosis of the lateral columns, it can scarcely be confounded.

Dr. Althaus shows that, in chronic spinal paralysis and in wasting palsy, the essential changes are in the anterior horns of the cord, and are similar to those found in anterior poliomyelitis.

As regards the prognosis and treatment of the group of diseases which he has so ably described, Dr. Althaus does not take a very favourable view. In the vast majority of cases he says there is ultimately partial paralysis with atrophy, deformity and contraction. "The results of treatment," he adds,

"have been somewhat discreditable to our art." The chronic form of polio-myelitis in adults is the only one that he seems to regard as at all amenable to treatment. Discarding the old and, until lately, approved regimen of calomel, cupping, leeches, and counter-irritation to the spine, he resorts, during the acute stage of polio-myelitis, alike in the infant and the adult, to the hypodermic injection of ergotine, which has been physiologically proved to contract the vessels of the spinal cord. By its action he hopes to avert the intense hyperæmia of the arterioles and small veins, and bursting of the capillary vessels in the cord, which are among the characteristic anatomical features of the disease. When the inflammation is over, he prescribes iodide of potassium, to induce absorption of exudations, to check excessive connective tissue growth, and so to allow those ganglionic cells which have not been entirely destroyed the possibility of regeneration. At the same time he insists upon the systematic use of the constant galvanic current, which should be made to pass through the diseased portion of the cord. Phosphorus and cod-liver oil may, he thinks, be beneficial, but he has not seen benefit accrue from the subcutaneous injection of strychnia.

But all these measures, however judiciously and patiently employed, yield but unsatisfactory results, and the truly appropriate and efficient treatment of anterior polio-myelitis remains to be discovered. Dr. Althaus has no hopeful anticipations to hold out, but I think we are fairly justified in looking forward to a largely-increased control over the morbid processes to which the anterior cornuæ are liable. The experiments of Feinberg point to methods of modifying the intra-vertebral circulation which may any day become valuable in treatment, and recent surgical observations indicate a power of regeneration in nerve tissue far greater than would have been conceived possible a short time ago. Then no doubt agents exist having a specialised action upon the great cells of the cord-connected with the outgoing currents, and we must look to experiment for the revelation of these. At any rate, in a disease so disastrous in its consequences, and hitherto so little held in check, there can be no folding of the hands or resting

content with the existing weapons of attack, which are admitted to be so ineffectual.

J. CRICHTON-BROWNE.

Minds and Moods: Gossiping Papers on Mind, Management, and Morals. By J. MORTIMER GRANVILLE, M.D. Renshaw, London.

THIS little work, slight and unlaboured as it certainly is, scarcely deserves the title of gossiping, for the talk is far from frivolous, and the morality is sane, sensible, and wholesome. We have had some difficulty in following the imaginings, as in the first paper on Thoughtland, where the few northern travellers are described as very cold and comfortless. "Only a small tribe, resembling the Esquimaux, are being very much wrapped up in their own muddish surroundings; the two sexes scarcely discernible at a distance: frosty philosophers, with some more stable fluid instead of blood, ever registering an equable temperature—a terrible number of degrees below freezing-point." Wherever these may be, the author does not belong to them, but rather to the dwellers in "the temperate regions of Thoughtland—a recruiting ground open to intellects of all orders and capacities, with suitable entertainment for each."

In the paper on Dreamland, our author says that those "who work hard with their bodies by day, and need physical rest at night, seldom dream," &c. We are inclined to differ from this opinion, and we believe that sleep is never quite dreamless. Indeed, our author in his paper on Rest seems disposed to adopt this latter view, when he says, "Profound slumber may be dreamless, or the impressions received by the memory too faint to be recalled."

The author does not say point-blank, like Sir Thomas Browne, that we are responsible for our dreams; but he teaches the doctrine that nothing comes out of our minds which has not previously been admitted, for "what a man or a woman dreams is an indication of the elements which compose the bases of character."

Miraculous or prophetic dreams are trotted up to without shying by the author's "own sober roadster, common sense." Of them he says:—

"‘Supernatural’ dreams are either coincidences, the fruition of some latent thought that startled the dreamer when it happened to be defined in sleep, or the result of a process which physiologists call ‘unconscious cerebration’—that is, the continuance of some process of thinking which goes on in the mind after the individual has forgotten that he set it in motion and supplied the impulse by his will. Most of the marvellous dreams which form the slender prop of decorated stories are of this nature. A suspicion, a fleeting thought passes through the mind that a calamity is about to happen. It is forgotten. The mind unconsciously works out the idea, and some stray impression, a momentary glance at some object, or the mere caprice of thought, brings it to the surface in a dream. The first idea, long past, was a shrewd conjecture—it is commonly among shrewd people that these dreams occur; the chapter of accidents—which is in truth a very methodical system of probabilities—explains the rest. It is much to be regretted that so many worthy and otherwise strong-minded people ‘believe in dreams,’ without troubling themselves to discover what these familiar but mysterious phenomena really are. Anything that gives men and women a plausible excuse for shaking off the obligations of personal responsibility is bad, and therefore injurious. Not even in sleep is the mind reduced to the position of subserviency. From first to last, waking and sleeping, our lives and experiences are what we make them."

In the paper on Cloudland, we think the author takes too sanguine a view of the curability of insanity when he says:—

"As a matter of simple fact, however, there can be no more mischievous impression than that what is called ‘mental derangement,’ pure and simple, may not be readily prevented, and cannot be *easily and safely cured*. In six cases out of ten insanity might be prevented at the outset if only there were a little more intelligence exhibited by those who are beginning to feel the tokens of a weakening power of self-control, which generally takes its rise in some moral delinquency unacknow-

ledged, perhaps unperceived. Eight out of every ten cases of actual insanity may be cured if taken at the very first outbreak of the malady."

There are no statistics of insanity which support this view even of the curability of the most recent cases; Thurnham, the most careful of statisticians, being decidedly opposed to it. Moreover, the condition upon which this curability is made to depend is an impossible one to realize; for how is a man who is beginning to feel the loss of self-control from insanity to exercise the intelligence demanded from him? It is before, and not after, the bounds of sanity have been transgressed, that a man exposed to insane influences may be successfully taught the rules of mental hygiene, as was long ago expounded in that brochure by Barlow, on the power of a man over himself to prevent insanity. Another objection, and a fatal one, is that not six cases out of ten of insanity, nor anything like that proportion, result from moral causes of any kind, much less from any moral delinquency.

The paper on Spiritland is spirited, and we quite agree with the author in his liking for a good old-fashioned ghost, and in his notion that "a firm belief in spirits is essential to a comfortable idea of Christmas. To conjure up a ghost for your use you must take Leonardo da Vinci's recipe to compose a battle-piece," and "stare at a smoked or daubed wall, until 'thought shapes the vision into a scene of headlong confusion of arms and men.'" Dr. Granville, however, would not, like Aladdin's evil genius, swop old lamps for new. He prefers crusted port, and lamps with the *verd antique*, and "the grand old ghost of half a century ago, who would have scorned such trivialities," as,—

"The modern mode of retailing spirits at *séances*—got up for the delectation of middle-aged persons of weak mind and prurient tastes—is not in any sense an improvement; spirits out of Spiritland like fish out of water, at the best panting and feeble spectres, with no thought or faculty above the thumping of table-legs and banging of tambourines, with perhaps a little slate-writing."

Our author is sound, though not profound, on the subject of Will, which indeed is a subject not well adapted for any paper

which can even be called gossiping. This term, which is more often used as a veil for ignorance than any other in the language, this abstruse *tertium quid*, this undiscovered element, this inconceivable residuum which divines use to explain sinfulness, legists to stamp the character of crime, and mental physicians to hide the insanity of their conceptions, Dr. Granville boldly declares to be desire. He would have hit the mark more in the midst if he had qualified his statement, the "Will is desire," by saying that will is a desire strong enough to produce effort; for much desire is, so to say, latent, and carved into no form of action, mental or physical, and therefore fails to conform to the notion we must entertain of what other people evidently intend to convey by the term. Our author says explicitly:—

"*Will is desire.* It springs from a longing to gratify some impulse. It works by determining the mental and physical forces to a particular end. It is amenable to all natural influences, stirred within, or operating from without. It is also capable of being so instructed and informed by education, knowledge, and experience as to be controlled in its action by considerations wholly intellectual. It retains the sceptre of self-government throughout life, unless consciousness is suspended or the mind becomes diseased. Except under these two last-named conditions, conduct is voluntary and admits no excuse. A weak will is, in other words, a wanton will, dallying with duty, and seeking a cover for wrong-doing in the pretence of being misled."

The paper on Self is thoughtful and thought-provoking. The line taken is the paramount importance of right self-culture. As Polonius says:—

"This above all,—to thine own self be true,
And it must follow, as the night the day,
Thou canst not then be false to any man."

Or as that shortest and most piquant of proverbs, "Each one mend one," which, if obeyed, would soon wash most of the burrs and dirt from the face of society.

"Self-knowledge," says our author, "is the cardinal duty, self-respect the first guiding principle of life." Self-depreciation, if the investigation is carried far enough, ends with the

discovery of an abyss of corruption from which we turn away loathingly.

The humility gained by taking distorted and morbid views of self, like that acquired by gazing dreamily at the tokens and relics of human mortality, is neither useful nor ennobling. It never nerved a man for great deeds, or inspired him with really grand and elevating ideas. The true policy of self-knowledge is to look for the good in human nature; it is in this way that the natural safeguards of life and conduct will be strengthened, and a spirit of purity and goodness engendered by the rising principle of self-respect.

In the paper on Rest, we are disposed to question the doctrine laid down, that "its essential principle is *relief*,"—a term which only one partially agrees with, the notion of rest as cessation from motion. The relief of a spring means giving it freedom to act, which is the opposite of rest. Mental rest may indeed mean relief,—that is, removal from one train of thoughts to another, like the relief of a sentry; and it is quite true that mental rest is not otherwise attainable; but the author seems to have included too much within the meaning of his term, and especially when he not only makes it consist of relief but recuperation. The subject, however, is too wide to embark upon usefully on the present occasion.

From the concluding paper on the Burden of Life we quote the following vigorous passage :—

"It is, too, becoming a question of common sense, and one of no inconsiderable importance, whether some of our instructors are not pushing the pursuit of health and longevity to the verge of the ridiculous. If we are to be converted into a nation of valetudinarians, laid up in lavender, amid surroundings elaborately prepared to exclude disease and shut out death, and compelled to live under a 'rule' as irksome as that imposed on certain orders of ascetics, it will be time to ask if emigration to a less laboriously and exclusively healthful clime may not prove a relief from the toil of bearing a burden ruthlessly exaggerated. By all means rid civilized life of the parasites and creepers which have grown upon and surround it. Amend the errors and defects of great cities, reform and reconstruct the conditions of an existence carried on in such

breathless haste that there has been neither time nor strength to spend upon its own necessities ; but let this good work be accomplished without crazing the world with total abstinence or any other totalism which tries to substitute sentiment for sense, and proceeds on the assumption that men and women must be treated as children, to be kept from everything that may be abused instead of being trained in its use. Obviously, for example, temperance is incompatible with teetotalism. No one can be temperate in the use of an article from which he is wholly debarred. It is a moral triumph to inculcate temperance, because the faculty of self-restraint is thereby developed and strengthened—and this faculty is the only trusty safeguard against excess of every and any kind. Meanwhile it is degrading to the intellect and character to enforce total abstinence. It is like putting gloves on a lunatic to prevent his injuring himself. It is not the way to elevate ‘the people,’ and it is time to speak out plainly on the subject of a craze which is working wondrous harm by enfeebling the national character it pretends to improve. The man who succeeds in using intelligently what he has hitherto abused has acquired a force of character which will serve him and advance his interests in many directions besides that of moderation in the recourse to stimulants ; meanwhile self-government gives him a new aim in life, and the pursuit brings him happiness.”

These desultory papers touch many subjects which interest us deeply, and we venture to hope that the outline of manly and wholesome thought traced in them will some day be filled up by the author with the care and labour which it so well deserves.

JOHN CHARLES BUCKNILL.

A Practical Introduction to Medical Electricity: with a Compendium of Electrical Treatment. (The latter translated from the French of DR. ONIMUS.) By A. DE WATTEVILLE, M.A., B.Sc. Lond.; Assistant Physician to the Hospital for Epilepsy and Paralysis; late Electro-therapeutical Assistant to University College Hospital.

THIS little book will, we believe, be of great use to many, and especially to those who, already knowing much of both elec-

trical science and of disease, have not yet been able to apply their knowledge of the one to their treatment of the other.

It deals successively with the "electric current," "apparatus," "electro-diagnosis," "electrization," and "treatment." The second chapter, that on "Apparatus," furnishes a very complete account of the various batteries and other implements, upon which the greatest reliance may be placed. It is well written, and fully illustrated by drawings. The third chapter, on "Electro-diagnosis," is practically useful, although not so complete in minute detail as that which we hope to see in a future edition. The fourth chapter, on "Electrization," contains very many valuable hints, and some acute criticism of the work done, or proposed, by other writers. With regard to the first and last chapters, we will speak hereafter.

The object of M. de Watteville appears to be, to give a more definite basis than that which has been hitherto given, in books on Medical Electricity, to the superstructures which have been raised thereon with regard to the ascertained facts of the behaviour of electrical currents; and, further, to supply minute and specific directions as to the mode of their appliance in the treatment of disease.

In respect of the latter, the medical application of electricity, the author has followed, as he states in both his title-page and preface, the writings of Dr. Onimus. He has, however, furnished, clearly, directions as to the form, force, and locality of such applications, and has enriched his book with copies of woodcuts, exhibiting very plainly the points to which the electric current should be applied in order to produce those special effects on individual nerves or muscles which are desired, but with regard to which a large amount of practical ignorance prevails. There is much in this section which we, from our own experience, should regard as somewhat romantic; but for this the author is less responsible than is Dr. Onimus.

The first chapter contains much valuable information; but we hope that in a second edition its author will endeavour to take for granted that many of his readers may know nothing, and will avoid the introduction of unexplained terms, and so expand his statements as to make his teaching thoroughly

intelligible to those who may have had no previous education on the subject. Great credit is due to M. de Watteville for the good style of English in which his book is generally written; but we are sure that so able a linguist as he is, will, by further revision, render its composition unexceptionable. We heartily commend the book to the careful study of those who are interested in electro-therapeutics.

J. RUSSELL REYNOLDS.

Déjerine on Diphtheritic Paralysis.

IN the 'Archives de Physiologie' for April, M. Déjerine gives an exhaustive account of researches made by him on lesions of the nervous system in diphtheritic paralysis. The five cases which were investigated occurred at the Children's Hospital of St. Eugénie in Paris.

M. Déjerine lays great stress on the experimental methods which he adopted. Of these there is only need to mention for further investigation the mode of examining the spinal nerves. They were placed in a one per cent. solution of osmic acid for twenty-six hours, afterwards washed with distilled water, treated with picrocarminate of ammonia and other staining fluids, and then teased and mounted in glycerine. The main conclusions arrived at are the following:—

1. There exists in paralyzes consecutive to diphtheria a lesion of the anterior roots; this lesion, analogous to that which is observed in the peripheric end of a cut nerve, is of an inflammatory nature.
2. This lesion was constant.
3. The alteration corresponded rigorously with the paralytic phenomena observed during life. In cases where the paralysis was confined to the upper limbs the alteration of the roots was not observed to extend beyond the first dorsal pair.
4. The degree of alteration was in direct proportion to the duration of the paralysis.
5. The posterior roots never presented any definite lesions.
6. Examination of the spinal cord seemed to demonstrate

that this alteration of the roots was secondary and consecutive to an alteration in the spinal cord.

7. This change in the spinal cord is probably inflammatory in nature; it is situated in the grey substance without affecting the white. It is slight in amount, and has no special localization to any group of cells.

The alteration in the anterior roots of the spinal nerves which M. Déjerine has so constantly found in these five cases must be accepted as a distinct addition to our knowledge, although Buhl had already described in one case swelling of the anterior and posterior roots, and of the intervertebral ganglia. M. Déjerine contends strongly for the central origin of the change in the spinal nerves. According to his view, there is a slight myelitis affecting especially the anterior horns, for the change in the anterior roots is secondary to this myelitis.

With the exception of the first case, where it is reported as healthy, there is no note of any examination of the medulla oblongata, and there is no record at all of the histological characters of the nervous and muscular structures of the soft palate, although in every case there was paralysis in that region. In the absence of negative experimental evidence on this point, we cannot consider that M. Déjerine has demolished the view urged by Leyden and others, that an ascending neuritis is in many cases the cause of the nervous disturbances subsequent to diphtheria. It is certainly of great significance that paralysis, even when generalized, in the vast majority of cases, begins with affection of the soft palate. It is not at all an uncommon experience that a child may have had a diphtheria not sufficient to keep him confined to the house for more than a week; but succeeded within three weeks by altered speech, regurgitation of fluids through the nose, defective accommodation, and some ocular palsy, without any other paralytic condition at all.

In the absence of anatomical proof, which is the more likely hypothesis, that these conditions result from a central lesion (to which we presume M. Déjerine's views would tend), or from an inflammation of the muscular substance of the palate, inducing a neuritis of some of the branches of the pharyngeal

plexus and an extension by means of the carotid plexus to the lenticular ganglion?

From the clinical varieties observed, there seems the strongest reason to believe that this inflammatory condition is sometimes a neuritis only, whilst in other cases it extends upwards to the bulb, and down certain tracts of the cord.

There is a strong presumption for the reasonableness of this view in the analogy of the so-called reflex paraplegias occurring subsequently to dysenteric and vesical ulcerations. It cannot be too plainly stated that the anatomical proof of an ascending neuritis being the *modus operandi* in these cases, is still incomplete. We are only concerned at present to point out that M. Déjerine in his experimental researches has not disproved it.

It is quite possible that in grave diphtheria, as in many infective diseases, there may be vascular and other changes of the nervous tissues, occurring as part of the general infection—and along with these the myelitis and disease of the anterior roots observed by M. Déjerine doubtless find a fitting place; but if the clinical history of the milder cases means anything at all, the phenomena observed must arise in quite a different way.

M. Déjerine contends strongly against the specificity of diphtheritic paralysis, and would put it in the same group with the cases of paralysis after typhoid, typhus, and small-pox.

It appears to us that this classification should be accepted with reserve, for some of the nervous lesions observed after the acute specific diseases are undoubtedly embolic in origin.

That a paralysis beginning at the soft palate and becoming more or less generalized is not *indubitably* diphtheritic is proved by Senator's important case, where such a condition followed on abscess of the tonsil; but seeing that in the multitude of palato-pharyngeal inflammations this form of paralysis is excessively rare except after diphtheria, it may be taken as sufficiently characteristic for practical purposes. Senator's case is quite in accord with the doctrine of a neuritis migrans.

T. BARLOW.

Munk on Localization of Function in the Brain. 'Weitere Mittheilungen zur Physiologie der Grosshirnrinde.' Verhandl. der Physiolog. Gesellsch. zu Berlin, Nos. 9 and 10. April 12, 1878.

IN a communication to the Physiological Society of Berlin, on March 23, 1877, Herr Hermann Munk announced that he had discovered that in dogs the brain was divided into a sensory and motor region by the fissure of Sylvius, and that destructive lesions of certain parts of the cortex caused loss of sight and of hearing respectively. The figures which accompany the present communication enable us to see where he localizes the visual and auditory centres—this being impossible in his first communication, as the references were not illustrated. The former is situated at the posterior part of the second external convolution, and the latter at the posterior and lower extremity of the third external convolution.

The lesions will be seen to involve the regions in which I have localized the visual and auditory centres in this animal (see fig. 32, 13 and 14, p. 149, and §§ 65 and 66, 'Functions of the Brain').

Herr Munk did not allude, adversely or otherwise, to my results in his first communication; but being "aufgefordert" to do so, he added an appendix, in which he effectually disposed of them with a contemptuous epithet and a point of exclamation; and he says in his present paper that he did not think it necessary to mention my 'Einschlägigen Untersuchungen' in the first instance, "because he had nothing good to say of them."

Having localized the visual centre in the dog near the posterior extremity of the hemisphere, and apparently regarding the occipital lobe in the monkey as homologous therewith, he came to the conclusion, before having made experiments on the subject, that the visual centre in the monkey was situated in the occipital lobe.

After making some experiments, he has succeeded in convincing himself that when the whole of the convexity of the occipital lobe in the monkey is destroyed, the animal becomes

hemipic; and that when both lobes are similarly destroyed, the animal becomes completely blind.

He disposes of my results on the ground that the observations were made before the general constitutional depression consequent on the operative procedure had passed off, but with considerable *naïveté* comments on the same page, on the remarkable absence of constitutional disturbance in the monkey after cerebral lesions, stating, though the remark is not quite original, that "the monkey, even after twenty-four to thirty-six hours, appears free from fever, and as well as before" (p. 41).

Assuredly, if conclusions as to the cause of derangement of special functions were to be drawn from observations made during a state of general constitutional perturbation, they might be objected to with justice.

But if it should happen that, after destruction of a certain part of the brain (whether constitutional depression existed or not), a certain function should show no signs of impairment or derangement, we should have a very conclusive proof that the part destroyed had no relation to this function; and there would be very substantial grounds for attributing any derangement which might occur subsequently to secondary changes, and the extension of the lesion to centres not actually injured in the first instance. I have drawn attention to these sources of fallacy, and, keeping them in view, endeavoured in my researches to carry out exact observations, and compare the phenomena with the experimental lesions before such complications could arise. I have specially called attention to the danger of interfering with the true visual centre—the angular gyrus—when the experimental lesions in the occipital lobe trench too closely on the parieto-occipital fissure, and have found, on careful post-mortem examination, that in all cases in which vision was impaired in connection with lesions established primarily in the occipital lobe, the angular gyrus was more or less affected. Herr Munk does not appear to have paid any attention to such precautions, or to have actually tested the results of lesions accurately limited to the angular gyrus.

In Experiment 22, Phil. Trans., 1875, vol. ii. p. 478, the

following note occurs of an observation made on a monkey in which both occipital lobes had been thoroughly broken up, as indicated in the accompanying figures (figs. 29, 30, 31):—

"5.45 P.M. [an hour and a quarter after completion of the operation].—Gives emphatic evidence of sight. Ran away when I approached it, carefully avoiding obstacles. Seeing its cage-door open, it entered and mounted on its perch, carefully avoiding the cat which had taken up its quarters there. Tried to escape my hand when I offered to lay hold of it, but picked up a raisin which I had left on the perch."

Herr Munk may possibly be able to explain how these things could be done by an animal in a general state of constitutional depression and deprived of sight; but if an animal can act to such purpose after removal of its visual centres, it would appear to find little use for them.

Herr Munk further finds the "Fühlsphäre," or region of tactile and common sensation, in that part of the brain of the dog usually termed motor; and he announces that in the monkey it is situated immediately anterior to his visual centre: but whether he has actually found it, or is only going to do so, is not quite clear.

In his facts and inferences on this point he adds little or nothing to what has already been stated by Schiff, and conclusively refuted by the best of all evidence on this head, viz. clinical and pathological observation.

The question of cerebral localization remains much in the same position as it was before Herr Munk began his valuable researches.

D. FERRIER.

The Nature and Treatment of Rabies or Hydrophobia. Being the Report of a Special Commission appointed by the 'Medical Press and Circular.'

THIS volume is the result of the investigations of a special commission appointed to inquire into a subject which has recently been prominently before the public, and widely discussed in both lay and medical journals, "assuming the

aspect of a question so important as to agitate the country from end to end, disturb the very relations of life, and excite suspicion and distrust of our poor four-footed friend the dog."

It may be questioned whether the discussion of such subjects in ordinary journals is expedient, tending, as it must, to excite the imagination, arouse morbid expectancy, and thus predispose the nervous, timid, and excitable to suffer from a disease which, whatever may be its true origin, is doubtless one of a character to be intensified and exaggerated by strong mental impressions. There cannot be, however, any doubt that the subject is one essentially appropriate to medical periodicals, and the report in question affords ample evidence of the value of such discussions, for it has brought together, in a clear, lucid, and succinct manner, all that past and present knowledge has to say in regard to the history, etiology, pathology, and treatment of this very interesting and obscure disease.

It shows not only how much, or how little, we know, but it indicates the direction in which we may look for more light; and, whilst admitting freely that the subject is one of much obscurity and difficulty, it still takes a more cheerful view than that generally hitherto held, and declines to superscribe the portal of the hydrophobic sufferer with the gloomy words,

"Lasciate ogni speranza voi che entrate;"

rightly refusing to admit that, because treatment in the past may have been so often irrational and unscientific, there are necessarily special conditions in rabies to preclude the hope that advancing science in the present day may enable us at last to grapple successfully with this as it has done with other difficulties erewhile regarded as insurmountable, and declaring that the word "despair" should be erased from our vocabulary: for, having certified cases of recovery on record, we may reasonably look for still further conquests over the disease, and anticipate that rabies "will ultimately be controlled with as much certainty as dilatation of the pupil is produced by atropine,* or its contraction by Calabar bean." Whether it prove to be so or not, this is at all events a hopeful

view of the matter, and rightly expresses the spirit in which we should pursue our investigations of what is, after all, but one of the manifold affections to which humanity is liable, and, dismissing all prejudices and old traditions, go on anxiously seeking all the information we can acquire respecting the conditions under which the disease is developed—its pathology and the means by which it may be prevented or controlled; and that by thus gradually unravelling the secrets of Nature, Science may at length achieve further legitimate triumphs.

The report is divided into fifteen chapters, each of which is full of interest, dealing with the statistics of the disease in past times, and noting the conclusions arising therefrom. The morbid anatomy and pathology, etiology, symptomatology, the period of incubation, frequency, and mode of transmission; the treatment, curative, preservative, and preventive; the curiosities of treatment and of its literature, are all fully considered. A synopsis of rabies in animals, an historical and bibliographical account of the disease and its geographical distribution, are given; whilst the two last chapters are devoted to a chronological table of authorities since 1870, and a complete bibliography chronologically arranged. Space will only admit of a few remarks on some of the more important points discussed in this very complete and interesting monograph.

It begins by pointing out that the problem of the nature of hydrophobia has yet to be solved, the period of incubation has to be accurately defined, the exact part of the organism affected to be clearly demonstrated, and the remedy yet to be submitted to the test of further experience before we can pronounce on its powers. It observes how essential it is that facts should be accurately noted, and their true nature critically determined; for neglect of this has caused cases to be reported as rabies that were really due to other pathological states, such as tetanus, acute mania, and certain forms of cardiac disease: some instances are cited in proof of this, whilst others show that nervous influence and powerful mental emotion may originate mistaken diagnoses. Certain questions, it is suggested, demand examination:—

Can hydrophobia arise spontaneously in the lower animals?

Is it communicated only by animals who use their teeth as weapons of defence?

Does it arise spontaneously in the human species?

Can it be communicated from one human being to another, or by the human species to other animals?

Are there any facts showing the poison may be introduced without a bite?

Is the evidence of Girard and others who deny the existence of a poison satisfactory?

And, as far as our present knowledge admits, replies are furnished to these queries.

Statistics afford evidence that it does not follow as a matter of course that hydrophobia will invariably develop from the bite of a mad dog. Just as the poisons of cholera, typhoid, and diphtheria do not affect certain organisms, so the poison of a rabid animal seems inert in some cases; and, considering the number of persons bitten in Great Britain yearly, it affords some consolation that the proportion of real cases of rabies is comparatively few. The knowledge of this should soothe the public mind, which becomes needlessly alarmed by reading and hearing sensational accounts of the disease.

An analysis of 150 cases of so-called hydrophobia gives 103 deaths, all from true rabies; 10 genuine, and 12 questionable recoveries—*i.e.*, in the latter the cases were not proved to be real rabies. There were 17 cases illustrative of the spurious or imitative form, and 8 in which the evidence of their real character remained doubtful.

If we separate the spurious and doubtful, we have 103 genuine cases of the disease remaining, of which there were 10 genuine recoveries under various kinds of treatment: 1. Salines, aperients, blisters; 2. Mercurials and excision; 3. Mercury; 4. Iodine; 5. Cautery, vinegar, *genista lutea*; 6. Calomel; 7. Cautery, Indian hemp, chloroform, morphia; 8. Cautery; 9. Morphia, chloroform, curara; 10. Curara. Ten recoveries out of 113 cases of genuine hydrophobia is a better result than is generally supposed to attend that disease, and gives hopeful assurance that we may look for better still, when

increased experience and further investigation shall have thrown clearer light on its etiology and pathology, and on the nature of the virus.

Without questioning the efficacy of treatment in the 113 cited cases, it may be permitted to suggest that possibly recovery may have been due in some of them to the smallness of the dose of the virus inoculated, to the natural vigour and strength, and to activity of the eliminative processes in the patients. There is no poison, however active, of which there is not some quantity that is not necessarily fatal. Such is the case in the colubrine and viperine virus; and it may be so in respect of rabies as of snake poison, and that recovery is due to this cause rather than to the effect of remedies, which for the most part are, as antidotes, totally inert. It may not, however, be denied that in some cases careful medical treatment, and its important adjunct, good nursing, may determine the saving of life that otherwise would have been lost.

Statistics show further, that under the head of hydrophobia certain cases are apt to be included that have no relation whatever to the specific disease produced by the bite of a rabid animal; as also, that nearly every form of treatment suggested by empiricism, superstition, and reason, has from time to time been employed.

It cannot be disputed that there is such a specific disease depending on a special poison, attended by the most distressing symptoms; difficulty of swallowing, rather than horror of water (which is really not always present), being one of the most marked phenomena. There have been, indeed, perhaps still are, authorities who attribute the entire train of phenomena to a perverted condition of the nervous system; but the evidence, on the whole, and especially as it relates to young children, dismisses the idea of its being due to an imaginary or nervous origin solely.

Rabies certainly is a specific disease communicated by a rabid animal, generally, though not invariably, of the canine family, and it is as definite and marked in its characteristics as tetanus, whooping-cough, or any other well-known malady. It is equally sure that this is not produced by the bite of a healthy animal, and that only a limited proportion of persons inocu-

lated are capable of developing the disease: in this it resembles many other diseases, while it differs from snake poisoning; for, so far as we know of the latter, though there may be degrees of toleration, there is not absolute immunity for any one.

A distinct affection of a nervous character, due to derangement in the motor centres, simulating hydrophobia, also occurs, and may prove fatal. There are, moreover, certain forms of heart disease and pericarditis in which similar symptoms are said to be produced, and, in illustration of these conditions, cases are adduced. It is since 1829 that we find the first foreshadowing of some rational explanation of the phenomena; and to Dr. Clifford Allbutt and Mr. Fleming, more recently, we are indebted for the first starting-point of a more advanced stage in the history of the pathology of rabies. The importance of accurate diagnosis, and the difficulties in its way, are set forth, and it is suggested that with the view of insuring more certain information, the powers of the medical department of the Privy Council might well be extended, and that as zymotic diseases come under their supervision, so should rabies; and thus, additional aid in noting, and scientifically observing and treating cases, wherever and whenever they occur, might be afforded with benefit to the public and the profession alike.

In regard to treatment by curara, a remedy itself so dangerous, its use under great caution and restriction is justifiable, and may be left to the discretion of medical men generally, for there is no reason to suppose that they would recklessly use so potent an agent. At the same time the strange anomaly presents itself of the physician being permitted to use on man himself that which he is prevented—unless he be a licensed experimenter—from using tentatively, for the benefit of the human species, on the lower animals.

The section devoted to the morbid anatomy and pathology is very interesting; it relates all the views that have been held from past times up to the investigations and discoveries of the present day. The phenomena and symptoms are declared to be due to the influence of a morbid poison, whose malignant influence is directed to the nerve-centres, but chiefly to the medulla oblongata. The morbid appearances in

the spinal cord and medulla, described by Allbutt, Coates, Benedek, Gowers, and others, are detailed: these are said to consist mainly of changes in the nerve-cells and vessels; and the presence of round cells, and leucocytes in the perivascular spaces, in the nerve tissues itself, and among the nerve elements, in granular degeneration and even embolism; such changes being most marked about the respiratory centres.

These anatomical investigations are of great value, but they are not conclusive: they tell of changes that have taken place, but they throw little light on the essential nature of the disease itself, and it is not impossible that similar changes may result from other diseases; but still they are important discoveries in relation to the pathology of hydrophobia. As regards the character of the virus, the long periods of incubation that often intervene between the bite and its consequence, and what happens to it during the delay, all is yet uncertain and conjectural. The true import of the so-called lyssi, whose very existence has been denied, is still unknown to us. The pathological changes in the centres already referred to show why certain phenomena were manifested, but nothing as yet explains how the poison has so acted.

The summary of our knowledge would seem to be "that the phenomena of rabies depend on structural changes in the medulla oblongata and spinal cord, influenced by a specific virus" originating in the lower animals, but the *modus operandi* of which is yet involved in obscurity. The important subject of treatment—preservative, curative, and preventive—is fully considered. The great object is to prevent the entry of the virus into the circulation, for which purpose ligature, canterbury, and excision are effective; and as we have no positive evidence as to the localization, or its duration there, of the poison, we are not to despair of success, should the bitten part not be so dealt with until some time after the wound has been inflicted, even so late as when it has actually cicatrized—though, of course, the earlier the better. Suction, it is observed, is not necessarily dangerous, unless the lips be abraded, as any virus taken into the mouth is at once ejected with the saliva, and the danger reduced to a minimum, as the

danger of absorption under these circumstances is infinitely small.

Local applications of cautery and cupping are recommended for similar reasons.

The old plan of excising the bitten parts, by cutting round a plug of wood inserted into each bite, is good, especially if done early. It has the advantage of adding to its intrinsic merits, that of giving confidence in the assurance that the cause of danger has been thoroughly removed.

Various forms of general treatment are described; they have met with comparatively little success, except as euthanasia. The value of curara as a remedy is still *sub judice*, and needs further inquiry. So deadly a drug must needs be employed with great caution; in a disease so desperate, however, the most extreme measures, provided they offer any reasonable prospect, on scientific grounds, of success, are justifiable, and should be employed. It may be that further experience of this agent, perhaps combined with artificial respiration, will yield satisfactory results. It would be more satisfactory if its action could be tested on the lower animals; this, however, is now impossible; so man must wait rather than they should suffer.

The various methods of treatment, such as with chloral, chloroform, and other narcotics and sedatives, and indeed all measures, whether curative, preservative, or preventive, are fully discussed.

The importance of preventive measures is insisted on, and the methods of effecting them pointed out. Suggestions as to how the canine species is to be dealt with in regard to his own and his master's welfare are made.

The volume concludes with an interesting chapter on the curiosities of treatment, and of its literature, which, like those that precede it, is full of interest, and will well repay perusal.

The Report is altogether a most valuable one, and will, as its authors say, form a *point d'appui* for future workers, and will stimulate further scientific inquiry into the nature of the disease. Such investigation is entrusted to competent hands; and from those of Burdon-Sanderson, Brunton, and Callender

"we may well look for more complete elucidation of its difficulties with hope and confidence."

JOSEPH FAYRER.

Cyon on the Functions of the Semicircular Canals. 'Recherches expérimentales sur les Fonctions des Canaux semi-circulaires.' Thèse pour le Doctorat en Médecine, par Élie de Cyon. Paris, 1878. 4to. p. 106.

IN his graduation thesis at the University of Paris, M. Cyon, the distinguished physiologist, formerly of St. Petersburg, discusses the functions of the semicircular canals, a subject to which he has devoted special attention, and on which he has published several valuable memoirs, the first of which appeared in Pflüger's *Archiv für Physiologie*, in 1873. Since his first researches the important observations of Mach, Crum-Brown, and Breuer, and others have appeared, and M. Cyon now reviews the whole literature of the subject, and adds many new experiments. He modifies in several particulars his former views, and comes to somewhat novel conclusions as to the functions of the semicircular canals in the formation of our notions of space.

As is well known, the experiments of Flourens on the semicircular canals form the starting-point of all researches in this direction. To explain the results first described by Flourens, and to interpret the vertiginous disorders such as have been described by Purkinje when the body is turned for some time on its longitudinal axis, and similar phenomena, is the main object of M. Cyon's dissertation.

His first series of experiments led our author to the following conclusions:—

"(1). To preserve the equilibrium of the body it is necessary to have a correct notion of our position in space.

"(2). The functions of the semicircular canals consist in furnishing us, by means of 'unconscious sensations' (*sensations inconscientes*), with a correct representation of this position. Each canal has a determinate relation to each of the three dimensions of space.

"(3). The motor disorders which result from section of the semicircular canals are divisible into three groups:—

"(a). Disorders of equilibrium as the direct result of the section.

"(b). Involuntary movements excited by abnormal sensations (auditory?).

"(c). Secondary phenomena occurring several days after the operation, and due to irritation of the cerebellum, &c."

Böttcher has attempted to show that all the results supposed to be due to section of the semicircular canals are in reality due to injury of the cerebellum during the operative procedure. M. Cyon disposes of this view very successfully, urging, among other arguments, that injury to the cerebellum (though no proof of such can be given), even if it did exist, would cause always the same phenomena; whereas the character of the phenomena depends entirely on the canal which is divided. Mach, Crum-Brown, and Breuer have attributed to the semicircular canals the origin of the impressions of acceleration of movement, or sense of rotation which is experienced when the body is rotated on a revolving disc:—impressions which are conditioned by the movement of the endolymph, in the reverse direction to that of the rotation of the body, causing irritation of the ampullary nerves: Purkinje's vertigo they account for by the conditions so established in the semicircular canals. Breuer in criticising M. Cyon's views considers that he advocates views little, if at all, differing from those clearly put forward by Goltz, viz. that the semicircular canals by virtue of relative differences of tension in the ampullæ are the source of impressions necessary for the due co-ordination of the movements concerned in the maintenance of the equilibrium of the head, and, through it, of the whole body. Cyon objects to this representation of his views, and endeavours to make out points of capital difference between himself and Goltz. He repudiates, above all things, being regarded as in any way holding that there are either central or peripheral organs devoted exclusively to the function of co-ordination of movements.

Though abnormal positions of the head may produce pheno-

mena almost exactly like those caused by section of the semi-circular canals, it is only indirectly that they do so, and the phenomena may occur without any changes in the position of the head.

The cause of the motor disorders must therefore be otherwise explained.

Taking up the views of Mach, Crum-Brown, and Breuer, respecting the movement of the endolymph, Cyon urges several theoretical and anatomical objections, and brings forward a series of experiments in which, by exposing the canals, and varying the pressure in them, evacuating them, fixing them, &c., he shows that none of the phenomena described by Flourens result; and that therefore the excitant of the ampullary nerves does not consist of varying degrees of pressure exerted by the endolymph. He refuses to attribute Purkinje's vertigo to the condition of the semicircular canals after rotation, and agrees with Purkinje himself that it is due to mechanical disturbance of the brain. How this causes vertigo, however, he does not further explain. Breuer had found that if the auditory nerves were cut on both sides in a pigeon, vertigo was not caused when the animal was rotated, but Cyon denies this, stating that apparently the same motor disorders occur as in the normal animal.

Proceeding to his recent experiments on the canals, Cyon calls attention specially to the fact of the *diversity of the movements* according to the canal which is divided.

His results agree in the main with those of Flourens as regards pigeons. These may be comprehensively generalized as follows: "Section of the two symmetrical canals causes oscillations of the head in the same plane as the canals."

The movements of the body follow those of the head, though they are more difficult to analyse, the animal turning somersaults head over heels, or the reverse, making movements of *manège*, &c. When all six canals are divided in the same animal, the motor disturbances are irresistible and indescribable. The animal dashes itself everywhere, and requires to be enveloped in a cloth to prevent fatal injuries. This state continues for three or four days, after which the animal may be set

free, but the motor disorders continue for from ten to fifteen days on the slightest attempt at change of position.

After this it seems gradually to learn to maintain its equilibrium by the aid of its other senses, chiefly sight. By the end of several months it acquires a considerable degree of stability, but it can never again fly, and the disorders always tend to occur when the animal is disturbed. It generally seeks a dark corner and remains still. When the canals only of the one side have been destroyed, the disturbances are less pronounced, and disappear much sooner. Hence, Cyon argues, the theory of Crum-Brown respecting the relations subsisting between the canals of opposite sides, *e.g.* the superior vertical forming one system with the posterior vertical of the opposite side, cannot be maintained.

Among other phenomena Cyon observed that after section of the canals on one, or both sides, but not symmetrical, the animal's leg would occasionally suddenly give way, and double up as if it had been broken. This giving way of the leg, like that seen in ataxics, generally occurred on the side of lesion, or, if the canals were injured on both sides, on the side on which the greater injury was inflicted. It particularly occurred when the vertical canal was injured.

Attempts were made to ascertain the effect of electrical irritation of the individual canals; but, owing to the difficulty of localizing this mode of irritation, little reliance can be placed on it. The principal result observed was a sudden deviation of the head away from the side irritated.

The results of section of the semicircular canals in rabbits differ in several important respects from those occurring in pigeons. The differences are principally:—

- (1) The motor disturbances are very violent, and of long duration in rabbits, even if only one canal is operated on.
- (2) The disorders are especially pronounced in the movements of the eyeballs, less so in the trunk, and are scarcely perceptible in the head.

The movements of the eyeballs are independent of those of the head, and Flourens was wrong in asserting that they ceased when the head was kept still. The direction of the movements depends on the canal which is irritated. As

regards the direction of the movements, Cyon modifies somewhat his statements in the memoir which he presented to the Académie des Sciences, in 1876.

He finds that excitation of the horizontal canal causes movement of the eyeball forwards and downwards; of the posterior vertical, backwards and upwards; of the anterior or superior vertical, backwards and downwards. This refers to the eyeball on the same side. The eye of the opposite side moves in a reverse direction, viz. backwards and downwards, forwards and downwards, forwards and upwards, respectively.

In his former experiments he found also that the pupil of the same side became contracted, the opposite remaining dilated. He finds now that this is not constant, and that frequently both pupils are dilated, but always most on the opposite side.

It is very difficult, on account of the position of the eyes in the rabbit, to reduce the various forms of nystagmus observed to their homologues in human pathology. Cyon proposes to work this out subsequently.

At the time M. Cyon formed his first hypothesis respecting the functions of the semicircular canals and their relation to ideas of space, he had not ascertained their relations to movements of the eyeballs. A consideration of these phenomena in their relation to each other led him to formulate certain definite conclusions as to the origin of our notion of space: "Granted that our notions of the disposition of objects in space depend especially on unconscious sensations connected with the innervation or contraction of the ocular muscles, and that each excitation, however slight, of the semicircular canals causes innervation and contraction of the same muscles; it is certain that the centres of the nerves which distribute themselves in the canals are in intimate physiological relation with the oculo-motor centre, and that consequently this irritation intervenes in a determinate manner in the formation of our notions of space" (p. 63).

This conclusion, he says, is only a restatement of the facts above related. Formulating his views with greater precision, he says, "The semicircular canals are the peripheral organs of the sense of space (*sens de l'espace*); that is to say, the sensations provoked by excitation of the nerve terminations in

the ampullæ serve to form our notions of the three dimensions of space. The sensations of each canal correspond to one of these dimensions. By the aid of these sensations we make a representation in our brain of an ideal space to which we refer all the perceptions of our other senses concerning the disposition of objects around us, and the position of our body among these objects" (p. 64).

Our author then proceeds to discuss and criticise the intuitional and empirical theories respecting the origin of our ideas of space. Discarding the intuitional view, he thinks that the ordinarily accepted empirical view which derives our notion of space from muscular sensations combined with local signs, is defective, and that this defect is made good by the discovery of a peripheral organ having for its function the origination of unconscious sensations corresponding to each of the three dimensions of space.

Starting from this basis, M. Cyon proceeds to analyse the phenomena of visual vertigo. It is known that after rotation of the body for some time on a longitudinal axis, as in waltzing, "a vertiginous sensation is experienced, in which all space seems to us to turn in another imaginary space, in a direction opposite to the movement of our body. The explanation," M. Cyon says, "is easy to find. Whatever be the nature of the troubles caused by the rotation of our body, it is evident that once the normal relations subsisting between the impressions derived from our eyes and those from our semicircular canals are deranged, there must result a temporary impossibility of harmonizing space seen, with the ideal space constantly present to our mind" (p. 75).

He comments on a curious fact noted by Mach, which Mach considered peculiar to himself, but which, it appears, is not so, viz. that when, during the rotation of the body, a phosphene is made by pressure on the eyeball, and the eye kept immovable, the phosphene also appears to rotate. The rotation of the phosphene, therefore, must have an origin quite apart from displacement of the retina, which is kept still. Mach accounted for this as follows, "that the optical space is projected into another space, which we construct by means of our muscular sensations." Cyon would say "sensation of exten-

sion" or "direction," instead of "muscular sensations." He states that movements of the eyeballs occur in him only if the rotation is slow, whereas in rapid rotation the eyeballs remain at rest. If during this a phosphene is made, it moves while the body whirls, and on sudden cessation the phosphene continues the movement for an instant, and then executes a movement in the reverse direction before ceasing altogether.

Contrary to the views of several authors, who state that visual vertigo becomes less, if it does not entirely disappear when the eye is suddenly fixed on a near object, Cyon finds that the vertigo is augmented by this procedure, so much so, in his own case, as occasionally to cause nausea and even vomiting. He is obliged, when he fixes his eyes, to sit down, otherwise he would fall. Visual vertigo, he says, may occur therefore with the eyeballs quite motionless and fixed. One might attribute the movement of the phosphene in Mach's experiment to sensations of innervation, even though this should not actually result in movement of the eyes. Mach rejects this explanation, which Cyon, however, regards as the only satisfactory one. But this does not suffice to account for the other fact that the phosphenes still move, when, instead of adopting the uncertain method of fixing the eye by the finger, we fix the eyes on a near object. Here it is evident that the sensations of innervation can only indicate fixation of the eyeballs. Hence, if the phosphene continues to move, it is clear that visual vertigo may occur altogether apart from the oculo-muscular apparatus, and therefore must be purely psychical in its origin.

This is the view which was first enunciated by Zöllner, in reference to the phenomena of M. Plateau and M. Oppel, and pseudoscopy.

Other considerations militate against the theory generally held respecting ocular vertigo, viz. that it depends on ocular movements unaccompanied by sensations of muscular innervation, and hence the movement of retinal images is projected outwards.

This explanation may suffice for ocular vertigo at the moment of its appearance, but the vertigo ought to disappear

as soon as the sensations of muscular contraction come to correct the illusion. Thus, after a time, those suffering from chronic nystagmus cease to experience any vertigo. And, in fact, there are conditions in which movements of the eyeballs may diminish, and others in which they increase the vertigo. In alcoholic intoxication the vertigo is increased by closure of the eyes, whereas in sea-sickness closure of the eyes diminishes it. In the one case external objects are fixed, and hence the muscular innervation of fixation of the eyes acts as a corrective to the vertigo, whereas in sea-sickness everything is in motion, and the brain is also subject to mechanical disturbance.

All the instances of illusory movements can be reduced to a dis-harmony between our perception and our ideal representation of space. Given the three co-ordinates representing the three dimensions of space, illusory movements will appear, whether the objects change their relation to the co-ordinates, or the system of co-ordinates alter their relation to the objects.

It was remarked that pigeons, after section of the semi-circular canals, preferred always to remain in a dark corner. This our author accounts for by supposing that the animals, thinking that the cause of their trouble is in the eye, seek obscurity to get rid of it.

Another fact which he quotes as showing that the motor disorders following section of the canals are due to dis-harmony between space seen and ideal space, is that pigeons which have been operated on preserve their equilibrium only when the head is kept in the most strange and abnormal positions. Thus, when the posterior vertical canal is cut, the pigeon rests with its head completely reversed, the occiput being held downwards, the left eye looking right, and the right left. A restoration to the normal position causes a recurrence of the motor disorders. It is to be concluded that, with the head so placed, the animal succeeds in harmonizing its visual and ideal representation of space. The position of the head is important as regards the maintenance of equilibrium, but Cyon, following Goltz, at first attached more importance to it than he now thinks it really has. In fact, all the motor disorders in pigeons may occur without any move-

ments of the head; and in rabbits, as has been seen, the eyeballs are especially affected. Oscillations of the head only augment, but are not the essential cause of the disorders. The motor disorders affect those movements principally which are chiefly employed by the animal in its orientation in space. Hence in the pigeon they are seen in the head, because the oculo-muscular apparatus here plays only a secondary part; in rabbits they occur chiefly in the eyeballs, while in frogs they affect principally the movements of the trunk, the head in their case possessing little mobility.

Summing up his views as to the phenomena consequent on section of the semicircular canals, our author says they are due, "(1) to a visual vertigo caused by the dis-harmony between space seen and ideal space; (2) to false notions resulting therefrom as to the position of the body in space; (3) to disorders in the distribution and graduation of the innervation of the muscles" (p. 91).

Regarding it as established that the semicircular canals are the peripheral organs of the sense of space, it is natural to ask, what is the normal excitant of the sensations? This Cyon considers a difficult point, but regards the views of Goltz and of Mach as disproved. He is inclined to attribute the excitations to vibrations of the otolithes, and perhaps of the epithelial cells which are connected with the peripheral endings of the vestibular nerves. As the sensations are "unconscious," it is naturally impossible to speak with absolute certainty on the subject. But, whatever may be the exact mode of excitation, it is certain, he says, that the canals are the origin of sensations in three planes perpendicular to each other, and that these unconscious sensations serve as the basis of our representation of the three dimensions of space.

As regards the relations, if any, of the semicircular canals to the sense of hearing, Cyon objects to Flourens' conclusions which assumed that section of the canals meant their paralysis; that, therefore, the indications of hearing continuing after section of the canals proved that they were not necessary to audition.

Section does not necessarily mean destruction, inasmuch as the recovery of pigeons after section of a canal indicates that

the function still continues. In order to decide the point Cyon extracted the membranous labyrinth bodily. Even after this, indications of acute sensibility to sounds continued. Hence, the nerve supplying the semicircular canals is not the nerve of hearing, and the so-called auditory nerve must be considered as composed of two nerves with distinct functions—the auditory, and the “nerve of space.” This division of the auditory nerve is borne out also by the two distinct anatomical origins of the eighth nerve as described by Stieda. Hitherto zoologists have been in the habit of regarding every terminal organ of the eighth nerve, or its homologue, as an organ of hearing. This, however, is more than problematical. An organ of hearing would be of little use to many animals, whereas an organ of orientation would be of immense service; and in fact, as we descend the animal scale, the cochlea is the first to disappear, while the canals and the sacculi persist.

He details some experiments on lampreys which have no cochlea, but only one sacculus and two semicircular canals.

The disposition of this organ is very unfavourable for acoustic purposes, being enclosed in a cartilaginous case, having only one opening (for the nerve), and covered by a thick cushion of muscle. Practically, lampreys do not exhibit any reaction to sonorous vibrations. On the other hand, section of the canals gives rise to very marked motor disorders, in all respects analogous to those observed in pigeons, &c.

On this point M. Cyon proposes to carry out further investigations.

The subject of which M. Cyon treats in this manner is one of great importance and far-reaching significance, and he has enriched it by many new and valuable observations. It would be impossible to attempt at this time to follow out in detail the bearing of M. Cyon's observations on the relations subsisting between the semicircular canals and the ocular movements. But it is obvious that the phenomena described by M. Cyon, and those which I have described as resulting from electrical irritation of the cerebellum, require to be considered together, and that M. Cyon's researches support the view which I have elsewhere expounded, that the cerebellum is the centre where that intimate physiological relation subsists between the

eyes and the semicircular canals of which he speaks. It appears to me, however, singularly unfortunate that M. Cyon should have mixed up physiological with metaphysical and psychological questions in the way which he has done. Cleared from this confusion, M. Cyon's facts and arguments establish very firmly the importance of the semicircular canals in the consensus of impressions on which our co-ordination in space is so dependent. But to make this co-ordination depend, as M. Cyon's language, interpreted literally, would imply, on abstract notions of space with three dimensions, and to explain physiological by psychical disturbances, is to confound things which ought to be kept separate. Surely M. Cyon does not consider it necessary that an animal should have formed an abstract notion of space with three dimensions before it can maintain its equilibrium. And how it is possible for abstract notions to be constructed out of "unconscious sensations" is difficult to conceive. Letting the term "unconscious sensations" pass without comment, not even Mr. Lewes would hold that centres endowed only with this form of sensibility are capable of ideation and abstraction. Yet we know that, after removal of the cerebral hemispheres, the functions of equilibration and motor co-ordination may remain intact. Cut the semicircular canals and the same disorders ensue. It can scarcely be said that in this case the motor disorders depend on a psychical dis-harmony between space seen and ideal space as M. Cyon puts it.

M. Cyon's work, however, may be considered apart from such defects, and I desire to express my high appreciation of its value.

D. FERRIER.

Clinical Cases.

CASE OF CEREBRAL TUMOUR.

BY JOHN HADDON, M.D.

JOHN H., aged 38 years, a warehouseman, was seen in March 1876.

Previous history.—Has always been a strong, healthy man until the present history began.

In September 1874 he noticed a swelling on the top of his head, which continued to increase in size until March 1875, and has not grown any larger since. His health was in no way affected by the swelling, so far as he knew.

In August 1875 he had an attack of severe vomiting, and was attended by a surgeon, who said it proceeded from inflammation of the stomach. During this attack he for the first time felt a slight tingling down the left leg; but it passed off, and he thought himself quite well again.

In October 1875 the left leg began to feel weak and numb, and at the beginning of 1876, when he had to use a stick in walking, he sought medical advice.

In February 1876 the left arm began to feel weak, and in March he became quite unable to walk alone.

When seen in March, he had a tumour situated just behind the coronal suture, to the right of the middle line, whose base covered an area about the size of half-a-crown; and the hypodermic needle, passed through its most prominent point, came in contact with the skull, when it had reached three-quarters of an inch from the surface. At the base of this tumour, and to its left side, a smaller tumour about the size of a horse-bean was detected. There was no pain about the tumour, and it was solid and nodulated.

He could not walk without help, and when walking the left leg was swung from the hip, by a movement of the

trunk. When the foot came to the ground, he could support his weight on it, so as to walk. As he sits he cannot move the thigh, leg, foot, or toes, but he can resist my bending the foot, and then the whole leg gets into a tremor. The left arm is numb and weak, but he can move it well enough.

Sensibility is unimpaired. The muscles are soft and flabby. He has occasional twitchings in the left leg, and suffers from pain round the body about the lower ribs, which often keeps him awake in the night. The right side is normal. The optic discs could not be distinguished from the rest of the fundus. His appetite is good, the bowels regular, and urine normal. He has no cough, or difficulty in breathing. His pulse occasionally intermits, and at times there is a systolic bruit at the cardiac apex.

In the beginning of April the movement of the left arm was awkward, the fingers remained straight, and looked useless.

On April 19th he could not move the left arm.

On April 21st a tumour of the cæcum began to obstruct the bowels.

May 5th.—The right leg is now weak. He complains of pain on the top of the head and in the left leg.

May 10th.—The right pupil is less than the left. He thinks he sees some one in the room, and his wife says he has strange fancies.

May 17th.—Left arm is rigidly contracted in semiflexion. The right hand shakes when he tries to use it, and the right leg is also partially paralysed. He complains of pain in the head.

May 19th.—Lies quiet with his eyes closed, and takes no notice. He cannot elevate the eyelids fully when he tries. He passes urine in bed. The left arm and leg are flaccid again. The voice is very feeble. He sweats profusely, and the pulse is 130.

On May 22nd he died quietly.

P.M.—The scalp being removed, the tumour was seen of a conical form, with a small one on its left side. On attempting to remove the calvarium, it was found adherent under the tumour. Force being used, the skull cap came away, with the tumour on its upper surface, and on its inner surface a thin and excavated part was seen, into which a tumour, now adherent to the dura mater, had fitted.

The thinning of the skull began half an inch behind the coronal suture on the right of the middle line, and was as large as a crown-piece in extent. The skull at that part was quite translucent, and the surface of the internal tumour had a rough spicular appearance.

- (b) The intra-ventricular portion of the corpus striatum.
- (c) The upper surface of the optic thalamus. In short, all that portion of the hemisphere intervening between the surface and the floor of the lateral ventricle was completely disorganized.

With regard to the portion of the tumour which rested on the left hemisphere, it may be mentioned that it compressed and dimpled the upper extremity of the left ascending frontal convolution, but it was not in any way disorganized by the tumour.

REMARKS.—The tumour would appear to have begun on the outer surface of the cranium, probably in the periosteum, whence it grew upwards for a period of six months, during which time there is no account of any symptoms. We have no history of any mischief until five months after it ceased growing upwards. During the five months it is probable that it was making its way through the bone. Having reached the dura mater, its growth would be more rapid; and it is probable that it was in August 1875 that the first pressure upon the brain occurred, and the point upon which pressure would first be felt must have been on the right of the middle line, and probably about an inch and a quarter behind the coronal suture. The first effect of the pressure was an attack of sickness, with tingling down the left leg.

The effect of the first pressure having passed off, he had no fresh symptoms for about six weeks. Paralysis then showed itself in the leg, and in the leg alone; and so well was he in every other respect, that the practitioner whom he consulted told him it was quite a local affection and would pass off. The leg gradually got weaker, and for five months it alone was affected. At the end of this period the left arm began to undergo the same process, but not until the paralysis of the leg was complete. In about two months after the first feeling of weakness in the arm it was completely paralysed. In another fortnight the right leg began to be affected, probably from the growth of the tumour across the middle line, upon the left hemisphere. A few days afterwards his reasoning powers became affected. In a few days more, rigidity of the paralysed left limb occurred, and continued for two days. Ptosis, probably paralysis of the sphincter of the bladder, and profuse perspiration were the only other symptoms before death, which was caused by a tumour in the cæcum.

It would appear, then, that the cerebral substance pressed

upon by the descending tumour was in the region occupied by the upper parts of the ascending frontal and ascending parietal convolutions, and the anterior half of the postero-parietal lobule; and further it is highly probable that these parts were pressed upon in the order in which they are mentioned.

We appear, therefore, to be justified in concluding, that pressure upon the upper part of the above-named convolutions of the right side in this case caused paralysis of the opposite leg, and that the centre for the leg is situated in this region, as indicated by Ferrier's researches.

TRAUMATIC LESION OF LEFT HEMISPHERE—
RIGHT BRACHIO-FACIAL PARALYSIS—APHASIA
—ANTISEPTIC TREATMENT—RECOVERY.

BY W. MACCORMAC, F.R.C.S.,

Surgeon to St. Thomas's Hospital.

T. S., ætat. 27, bricklayer, was admitted into the Leopold ward, St. Thomas's Hospital, on April 20, 1877.

Was working at some new buildings when a brick fell from a height of 30 feet, striking him on the left side of the head.

State on admission.—There was a contused scalp wound, somewhat semilunar in shape, just posterior to centre of left parietal bone: the scalp was stripped for about $\frac{1}{2}$ inch round the wound; the pericranium detached for about the same distance. There was an oval-shaped depression of both tables of the skull, and great comminution of the bone, which was driven some way into the brain. Pulsation was distinctly seen in the wound, and several small fragments of red brick were loose in it. Patient walked from the fly up the steps into the hospital. He appears to understand when spoken to, but cannot make any answer; did not make any sign of pain. Pupils dilated, and act slowly; they were equal. Soon after admission marked paralysis of right side of face was observed; tongue protruded to right side. Some twitchings of left side of face and limbs. There is loss of power in right arm.

Treatment. April 20, 1878, 11.30 A.M.—Under the carbolic spray, and without the use of any anæsthetic, Mr. MacCormac enlarged the wound backwards and forwards; the projecting edge of outer table was clipped away with a parrot-bill forceps. It formed an overhanging ledge all round the inner table, which was much more extensively fractured than the outer, and a number of pieces of bone, now rendered loose and accessible, were removed; one larger than the rest had punctured the

dura mater, and was driven about $\frac{3}{4}$ inch into the brain. The wound in the dura mater was of the area of a sixpence; the exposed brain was pulvified, and a small quantity escaped; the exact seat of the injury was about the mid-point of a line drawn from the tip of the ear to the sagittal suture of skull, and rather nearer the middle line than the ear. Several smaller pieces were also removed from the brain. These were covered with short hairs impacted between the fragments, and a small piece of his cap lining was also removed from the brain, together with a small black clot like a pickle of shot.

At the time of the operation the patient did not appear to feel pain, though he has since said he was quite conscious of what was going on. The wound was carefully cleaned with carbolic lotion, the edges were brought together with wire suture, and two small drainage tubes introduced at each extremity of the wound; carbolic gauze dressings were applied, and asepsis throughout maintained. Put to bed; had a cold coil applied to the head.

10 P.M.—Has not spoken. Temp. 102.2° ; pulse 68. Breathing steadily; limbs twitch at intervals; passes water naturally, making signs when he wants to.

April 21st.—Slept at intervals during the night; understands when spoken to; pupils equal; facial paralysis marked; right arm seems almost completely paralysed; lies towards the injured side. Wound dressed under carbolic spray, the edges in exact apposition and united. Scalp over wound pulsates, as does also the fluid in drainage tubes. A small quantity of bloody serum in dressings.

10 P.M.—Is shouting out; muscles still twitch; retches at intervals, but is not sick. Cannot answer questions, though he apparently understands them.

April 22nd.—Cried out during the night; still retches—no vomiting. Fluids inclined to dribble from right side of the mouth; wound dressed; no suppuration. Some stitches removed. Primary union took place throughout, except at points where the drainage tubes were inserted, and this even in the margins of the original wound which had been contused by the brick.

April 23rd.—Paralysis of right arm more marked; sordes round lip; tongue thickly furred and protruded to right side; lies quietly in bed; cannot speak; no more twitching.

April 26th.—Has been very quiet, and rather more conscious; no suppuration. Movements of eyes not affected; can evidently see; is very quiet; smiled on being shown a penny, and asked what it was. Given a paper upside down, he immediately turned it the right way. No loss of sensation in

right arm, though great loss of power. Scapular muscles not paralysed.

April 27th.—During the early part of the day patient seemed much as usual, but at 4.5 P.M. was suddenly seized with a fit of convulsive twitchings of the muscles of the face and jaws. He became unconscious. Pupils dilated; conjunctiva sensitive. The right facial muscles twitched violently; left not affected. Eyes persistently turned to right side. Left arm was rigid for the first ten minutes. Face flushed, but not livid. Temp. in right axilla 98.8° ; left 98.4° . Pulse 60, regular. After the symptoms had continued an hour he had a sudden epileptiform convulsion of the whole body, lasting about two minutes. The twitching movements now subsided, and by 6 P.M. consciousness had returned.

April 28th.—Passed a quiet night, and his condition seems the same as before the fit.

May 1st.—Power is returning in muscles of right forearm, as he can move his fingers and just grasp a hand. Takes notice of things going on in the ward.

May 2nd.—Has greater power in forearm this morning. Can give a fair grasp. Tries to answer questions, but can only mumble something that might be taken for "Yes" or "No." Was given a pencil and paper, but he could not take a good hold of it, though he evidently wished to write.

May 3rd.—Power increased in right arm; after a good many attempts to write his name, he wrote "Thom," and seemed to think it a great joke. Facial paralysis less.

May 6th.—Seems in better condition to-day; tongue cleaner, and not protruded to right side so much. Asked his neighbour how he was; wrote on a slate "tea, bread, and butter," and, when asked, said he was hungry.

May 9th.—Is improving fast. On being questioned, says he remembers how the accident happened, his being taken to a chemist, then to the hospital, and also remembers the operation; he remembers every little detail and fact; talks slowly, having at times to think of words to express himself. Has more power in right arm.

May 22nd.—Has been gradually improving. Can now talk fairly well. Facial paralysis almost gone; also paralysis of right arm.

June 1st.—The patient may be now pronounced convalescent. He has been up and about for some days. The strictness of his diet is relaxed. His speech is deliberate, but quite perfect; and all the bodily and mental functions appear to be otherwise quite perfect.

REMARKS.—So complete and satisfactory a recovery does not usually follow a depressed compound comminuted fracture of the skull, with injury to the dura mater and brain. Inflammation of the brain and its coverings, accompanied by suppuration, too often occur. The only untoward incident was the attack of convulsion on the eighth day. For fourteen days he may be correctly styled speechless. To any and every question he replied in the same way—with an inarticulate grunt. "No" was the first word which could be recognised. He was able to write what he wished to say before he could speak it, and would probably have been able to write much sooner but for the paralysis of the arm. His intelligence was very little, if at all, impaired. He had no symptoms of concussion, was able to walk into the hospital, and remembered perfectly the incidents of the treatment and the operation he was subjected to. The temperature chart is interesting. Within two hours of the injury the temperature recorded was 103.4° , which was certainly not due to any septic change. On the next and succeeding days it became gradually lower, reaching the normal standard on the seventh day, above which it never again rose. It was rather below the normal standard the day he was seized with the convulsion, during which it did not rise. There was at no time a tendency to fungous protrusion of the brain, thus corroborating the view that this is chiefly due to inflammatory hyperæmia and exudation. The man is now, more than two months after the injury, quite well.

Note by Dr. Ferrier.

Besides its importance from a surgical point of view, this case is of interest in reference to the localization of cerebral functions. It shows, like the cases which have been recorded by Broca, Sydney Jones, Simon, Proust and Terillon, and Lucas Championnière, that the occurrence of aphasia with lesion of the left hemisphere is no mere coincidence to be explained away by the greater frequency of lesions of the left hemisphere as compared with the right.

The exact seat and extent of the cerebral lesion could not be made out, but the position of the cranial injury was such as to ensure damage to the lower half of the ascending convolutions; and hence, as experiments would have led us to expect, paralysis of the face and arm on the right side, with aphasia.

The lesion seems, in the first instance, to have concentrated itself in the facial and oral centres, the motor centres for the hand and arm being only partially involved, but, as is so

CASE OF GENERAL PARESIS OF THE INSANE.

BY G. HUNTER MACKENZIE, M.D. EDIN.,

County Asylum, Gloucester ;

With Observations by F. A. MAHOMED, M.D.

W. G., male, æt. 39, married, coal merchant, admitted into the Gloucester County Asylum on 12th February, 1877.

History.—Was formerly a sailor; no hereditary predisposition to insanity, nor other constitutional disease. Had always enjoyed good health until a few months previous to admission; had lately had several "fits," recovering from them in about an hour. Has not been intemperate, nor addicted to sexual excess. Has been in rather straitened circumstances lately. Of a quiet disposition; has been married a little over three years, and is the father of one child. Mental derangement of about two months' duration.

Condition on Admission.

Physical.—Under the average height; fairly muscular; pupils slightly unequal, the left being the larger, and acting sluggishly. Facial curves not well pronounced, especially on left side. Tongue vibratory; articulation thick, with an especial difficulty in pronouncing explosive labials. Pulse 100, very small, with first cardiac sound almost inaudible at all the areas: slight comparative dulness at right supra-clavicular region. Urine phosphatic.

Mental.—Has delusions of grandeur—that he possesses money, estates, and everything else a man might wish for. Feeling of *bien être* well marked; says he never felt better or stronger all his life. Struts about in a grandiose style.

Diagnosis.—General paresis of the insane.

Course of Case. May 20th, 1877.—Has had several attacks of excitement, as also some congestive apoplecticiform fits. Had one of the latter to-day, when his condition was as follows:—

"At 11 A.M. he became momentarily insensible, and aphasic. Conjunctival vessels injected, pupils slightly unequal, the left being the larger; eyes rolling towards left; at its upper internal aspect the left iris is somewhat narrowed. Pulse 80, small, regular; left arm partially hemiplegic, with diminished sensibility. On recovering sufficiently to be able to walk, he dragged the left leg slightly, and could scarcely stand."

The subsequent course of the case was characterised by more or less excitement, interspersed with frequent congestive attacks, and with gradually augmented paresis. The excitement became more delirious in character, and subsequently, when the paralysis had greatly increased, and the patient was consequently more confined to bed, assumed a low muttering character.

Nov. 15th.—Is in a condition of low, muttering delirium, following an attack of acute delirious excitement. Present state:—Pupils slightly unequal, the left being the larger; both contract sluggishly, but more especially the left; muscles tremulous (*subsultus tendinum*), more so in the left upper extremity than the right; grasp of left hand slighter than right. Can stand erect with eyes closed, and feet wide apart. Reflex power present in legs. Asked to close his eyes, he protrudes his tongue, which is very vibratory, is soon withdrawn, and rolled about mouth. Head unsteady, jactatory, and falls forward to the right side. Lower jaw inclines to drop. Temp of left axilla $98^{\circ}3'$; right $98^{\circ}1'$.

Nov. 20th.—A severe attack of excitement has ended in a convulsive attack, from which he can be only partially aroused. The convulsions last about five minutes: pupils medium, slightly acting, unequal, the left being the larger; conjunctiva sensitive; reflex movements and sensation absent from feet, legs, and arms; mouth slightly drawn to the left side; clonic contractions of muscles of right arm and leg, not of face; falls towards right side. The application of snuff to nostrils did not produce sneezing. Two hours subsequently, he is still somewhat somnolent, but can grasp properly with right hand; breathing somewhat stertorous; resists forcible extension of limbs; will not allow his eyes to be looked at; reflex power present in both legs, mostly in right. Twenty hours subsequently, he had become very quiet, with *subsultus tendinum* and apparently augmented reflex action, especially on tickling soles of feet.

Dec. 8th.—Had a hemi-convulsive attack, affecting principally left arm and leg.

Dec. 11th.—This afternoon at 4.30 had an attack of coma without convulsions. His condition at 6.30 was as follows:—Temp. 96° ; pulse 110, rather full and soft; resp. 10 per minute,

with peculiar characters, the respiratory movement being stertorous, with short inspiration. This stage of coma was broken by the occurrence of a convulsion which commenced with gulping and other evidences of impeded respiration. The convulsions were now general and of equal intensity throughout the whole body, the head being turned alternately from side to side, the pupils widely dilated, and the breathing stertorous. Each lasted from two to three minutes, the muscular twitchings remaining longest on the right side. Immediately after the cessation of the convulsion the temp. was 96.7° , pulse 110, resp. 16,—the inspiration being a short sharp snort, and the expiration from sixteen to twenty times longer than the inspiration. The pupils became contracted and equal, and not acting, with no evidence of sensation or reflex power. The convulsions recurred for several hours, and at 10 P.M. the temp. was 100.1° , resp. 21, of the same character as before; pulse 115; clonic jactatory spasms of left arm and forearm; no muscular twitchings in legs, and almost none in right arm.

Dec. 12th.—At 9 A.M. temp. 99.3° , pulse 112, resp. 24; muscular spasms continue on left side. At 11.30 A.M. temp. 99° , resp. 20, pulse 104; consciousness slowly returning. At 7 P.M. temp. 99.5° , pulse 104, resp. 25, quiet; pupils in medium contraction, the left being the larger; unconscious.

Dec. 20th.—Has been in a condition of more or less somnolence since last report, with muscular twitchings of face; limbs rather flaccid, but occasionally the flexor muscles of arms were rigidly contracted. To-day reflex power and sensation in feet are decidedly diminished; the right foot is cold, the left hot; sensation deficient over whole body; has taken food very well.

Dec. 24th.—Died. Nothing worthy of note has occurred since last report.

(Autopsy refused.)

Dr. Mahomed has kindly made the following observations on the sphygmographic tracings¹ in this case:—

The tracings recorded in this case are of great interest; they may be divided into three classes or types, all of which are exceedingly well marked, and appear to occur under similar circumstances with invincible consistency.

1. There is the tracing obtained during periods of quietude. It is seen on March 27 and Nov. 14. It is a tracing indicative of contracted vessels (though not of "high tension," there being little or no evidence of capillary resistance), with a feebly and deliberately acting heart. This form of pulse is seen

¹ The pressure employed in taking the tracings is considerably higher than normal on account of a peculiarity in the instrument.

occasionally in health, but usually in more or less feeble persons. It is readily produced by the application of cold to the surface, or by cold bathing; it is seen in Addison's disease and in peritonitis; it is thus especially associated with conditions in which the sympathetic system is involved.

2. Another characteristic type is that produced by irritative fever; it is seen on Oct. 15 and Nov. 12. It is a quick, or rather "frequent" pulse, occurring in contracted vessels, and therefore producing only a short upstroke, yet with the percussion and dicrotic waves more evident than in the rest. From its frequency it would be the pulse of fever, but its occurrence with contracted vessels robs it of the usual characters of the febrile pulse, which depend chiefly on the dilatation of the vessels. A similar pulse is seen in some conditions of pyæmia, low forms of surgical fever, so-called irritative fever, and in the first stage of ague.

3. The last type is that indicative of the exhausted and failing heart; this is seen on Oct. 30, Nov. 10, Nov. 19, Nov. 20, and Dec. 4. The characters of these tracings are, first, the annihilation of the percussion wave, producing a sloping upstroke, the result of the enfeebled contraction of the heart; secondly, the absence of the dicrotic wave, owing to a similar cause, the contraction being too weak to produce a wave of elastic recoil.

The other tracings combine, more or less, the features of some two of these types.

ACUTE MANIA ASSOCIATED WITH ABSCESS OF THE BRAIN.

BY GEORGE H. SAVAGE, M.D.,

Bethlem Royal Hospital.

I HAVE seldom met with cases, dying in an attack of mania, in which coarse brain disease was found.

It is not uncommon to have acute symptoms with syphilitic tumours, and I have the records of three cases in which the insanity was due to such tumours, the local paralyses and the insanity passing off with treatment of the syphilis. These cases recovering, no opportunity was afforded of confirming the localization of the disease made from lesions of certain cranial nerves.

Cases die from attacks of acute mania, and every year at Bethlem we have one or more of such cases. In these the changes in the brain may be general, but they are minute, and not at once seen by the naked eye. In not a few cases, the death, though occurring in acute mania, is not due to it, the mental disease commonly masking other diseases. Thus we may find, *post mortem*, advanced phthisis, pneumonia, pyæmia, pleuritic effusion, or evidence of other severe diseases, that were not only unsuspected, but hardly to be detected—cough, pain, and even increased temperature, being absent.

Besides these masked cases, however, I have seen others die of acute mania, in whom no general disease was found, all the viscera being typically healthy. In these cases, the brain always showed some changes, if carefully sought, such as congestion of membranes, effusion of fluid, or a general softening of the brain. I have specimens, showing that a form of inflammation may be present, the cortex and membranes adherent, and leucocytes and new growth infiltrating the superficial layers of the brain.

In the case I bring forward in this paper, we have a distinct

lesion in a brain that was unstable by nature. The case presents many points of great interest.

In referring to causes of insanity, all authorities agree that the most important is an inherited tendency, or its equivalent, viz. a tendency shown to exist in the family by several near blood-relations suffering. In our case, the father died of some brain disease, said to have been "softening," but which I prefer to believe was a simple dementia rather than general paralysis; for the evidence of the rest of the cases goes to support the idea that, when the period of life associated with beginning decay was reached, the members of the family tended to die by their nervous systems.

Again, I have yet to learn that general paralysis in a parent tends to produce ordinary insanity in the offspring.

The patient had certainly three other female relations who have suffered from insanity, so we may be sure that she belonged to the class that is ever ready to break down.

In the three attacks of insanity, there were different exciting causes in each. I do not attach much importance to any one moral cause given; for one cause reacts on the other and complicates it, and also induces other physical disturbances, which all tend to the precipitation of the attack. The symptoms of melancholy that were seen in both sisters are noteworthy. It is my experience that it is very common to see sisters suffering from similar forms of mental disease, and we have had several pairs in Bethlem with the same types of disease. We have now two sisters suffering from delusional insanity, and the suicidal tendency is constantly seen to run through a whole family, or along the male or female side of a family.

I may also remark here, that I have seen certain families predisposed to suffer from similar causes. Thus I have records of both mothers and daughters who have had insanity following child-birth, and, in fact, we have at present in Bethlem a patient, whose mother had puerperal insanity, now suffering from insanity due to the same cause.

I subjoin the history of the attacks, from which the patient was under observation, and short notes of the attack of the sister, who was also under our care in Bethlem. The first attack of insanity was in 1862.

Sarah N., single, æt. 35. Aunt and cousin insane. Father died of "brain softening."

About five years before she had a love disappointment, and since then on several occasions had had short attacks of mental excitement, but these rapidly passed off, leaving no mental deterioration.

The exciting cause of the present symptoms seemed to be

money troubles. She said, "Fiends constantly prompted her to do evil things, and to escape them she must kill herself." She had cut her throat rather considerably.

On admission, she was dull and desponding, suffering from melancholia. She was treated with morphia and steadily improved, so that, at the end of three months, she was reported as well enough to go on leave, and was afterwards discharged cured.

Second attack in 1869.—Religious difficulties given as the cause of this attack. Symptoms similar to last attack. Loss of self-control; impulses to blaspheme. Had lost all pleasure in ordinary affairs. Suicidal, very anæmic and emaciated, having refused food. Untidy and dirty in her habits.

She slowly improved and went on leave of absence, after having been in Bethlem five months, and was again discharged well.

An elder sister, Mary N., was admitted into Bethlem in 1873, suffering from active melancholia. After three years' treatment she was discharged uncured, suffering from chronic melancholia of an active kind. This patient was constantly wringing her hands and saying, "I don't know what to do." This sorrow became quite automatic, for she ate and slept well, and gained some strength before her discharge.

Last attack in Sarah N.—Admitted March 13th, 1878. Business troubles given as the cause. About six months before admission, was noticed to be unlike herself, and to be generally in weak health, sleepless and restless. She however improved for a time, but the sleeplessness became more marked, and she was dull and anxious.

In the early part of March she rather suddenly became noisy and violent. She said she had "seen the Lord Jesus," and that "He talked with her." Fancied people had knives concealed and would murder her. She said "her bed was an infernal machine," and that she was "surrounded by devils." She had wonderful visions, talked incoherently, and was very violent.

On admission, she was noisily and incoherently happy, talking and laughing constantly day and night. She was kept up for some ten days or so, but was always rolling about the floor, and taking off her clothes. It was noticed that her tongue was dry and brown. She took only a small amount of food; the bowels were confined, but there was no sickness; pupils uniform. She was too restless to allow a careful examination of her discs. Pulse rapid, small, and compressible. For her own sake, she was kept in bed, and there remained more quiet, though she talked and shouted constantly. Tem-

perature on March 22nd was normal in axillæ, and 92° on temples; and then there were no signs of lung disease.

On April 23rd she was very dirty, and on the 26th we noticed that she had lost power over left arm and leg, the forearm was rigidly crossed over the chest, and the leg extended with the foot turned inwards. There were numerous petechial spots on her left leg; the right angle of the mouth was drawn up.

May 1st.—No alteration in her hemiplegia, but there were now signs of pneumonia in both bases. Temperature (in axilla) 103°, pulse 125, respirations 51. Breathing became worse, and she died on May 2nd.

Post-mortem twenty-three hours after death.—Only the head was examined; calvarium very thin and dense. On removing this, the right temporo-sphenoidal lobe was noticed to be flattened and bulging; on making a slight incision, more than an ounce of thick gluey pus escaped, disclosing a thick-walled abscess occupying the whole of this part of the brain. There was no communication with the ventricles, or with the outside of the brain. There was no diseased bone about the ear or elsewhere; the membranes were free over the abscess. The arteries were patent and normal. The corpus striatum and also the thalamus were softened and broken up, and around the vessels were large spaces. Over the whole brain the membranes were separable. There was general congestion of the pia mater, but no excess of subarachnoid fluid. The rest of the brain was normal in appearance.

I shall only make a few further remarks on the case that seem necessary.

As has so often been pointed out, the form of the attack of mental disease seems to be accidental. Over and over again have I seen patients suffering from excitement, *i.e. mania*, in one attack, and from depression, *i.e. melancholia*, in another. In the case here recorded, however, there was a marked family and individual tendency to melancholia, and the exciting causes also were given as of a depressing nature. In the last and fatal attack, we must look upon the abscess as the *real cause* of the *insanity*. The history of some months' illness is quite borne out by the thick walls of the abscess.

It is very unusual to find an idiopathic or primary abscess in the brain, and, as the post-mortem examination was only partial, we cannot exclude many possible causes of abscess. Of only one thing I am sure, namely, that it was unconnected with any disease of the ear or cranial bones.

The absence of any symptoms to lead one to suspect a large abscess in the brain is noteworthy. Thus a cause, sufficient to irritate into mania, may exist, and yet cause no other

symptoms, till other parts, such as the ganglia at the base, were secondarily implicated.

In the attack itself there were two symptoms that made one look upon it as unusual. In the first place, the tongue was dry and brown from first to last, while the temperature of neither head nor axillæ was raised.

The other symptom was the small amount of food taken. A patient so pleasantly maniacal—laughing and chatting—generally takes food freely, but our patient took little or none, though she had no sickness, and did not seem to suffer from nausea.

I am, at present, at a loss for a satisfactory explanation of the above symptoms. They led me to look on the case as exceptional. There was no inflammation of the membranes over the abscess, and thus the case is still more difficult of explanation.

UTERINE DISPLACEMENT CORRECTED AND INSANITY CURED.

BY GEORGE H. SAVAGE, M.D.

In a very great number of cases the expression of the insanity is due to some wrong interpretation of general or special sensations. Thus the hypochondriac with a tendency to insanity has vague, uneasy feelings in his abdomen, and says that he has lost his intestines. Other cases have perverted impressions of many of their senses, and build up an insane intellect out of false or subjective sensations, and are necessarily incurable, as no true or ordinary impressions can be made on them.

The case that I have particularly to draw attention to in this paper does not come under either of the above heads, but is related to both classes, as we shall see. The patient had a definite cause of irritation in a prolapsed uterus, she was also unsettled and unstable from climacteric troubles, and was thus very impressionable, though there is no clear history of neurosis in her family.

E. G., married; forty-five. Has had five children; the youngest is six years old. No history of insane relations.

Cause.—Change of life. First symptoms two months before admission. She began by neglecting her home duties, or performing them badly. She attempted suicide. Destroyed her clothes, and threatened those near her because they "injured her." She wanted to leave home. On admission she was fairly nourished and willing to assist in ward work, but she was always complaining of the injuries done to her. She said that persons put ammonia and acids on all parts of her, and tried to injure her by putting chloroform on her pillow. She destroyed her clothes, and was very demonstrative against the harm done to her. .

She continued to have the same delusions without any change for two months. Morphia was tried; it produced

sickness, and did no good, and she refused to continue its use.

We found at this time that her menstruation had for some time been irregular, and that she had had the flushings of heat so common at the climacteric.

Salines and mineral aperient waters produced no good effect.

I discovered that she had a large heavy uterus which was much prolapsed. So I kept her in bed for some days. She was more quiet at first, but finding the uterus would not keep its place when lying down, I used a pessary with a bag at the end, and thus thrust up and maintained in position the uterus.

Within twenty-four hours the patient was more comfortable, and, though she complained of the "chloride of lime" a little, she was evidently improving. Within a week she was comfortable, but the temporary removal of the pessary again caused mental distress.

In three weeks from the introduction of the pessary she went home to her husband, and has remained quite well ever since, now four months.

Local causes of irritation frequently react on the mind, and, though I do not attribute so much trouble to simple uterine displacement as some have done, I have seen many cases in which ovarian or uterine irritation have had some part in the production of the insanity, or else have modified its expression.

Quite recently we had a case in which there was constant tendency to masturbate: the patient seemed quite unable to resist rubbing the clitoris. A pessary (a Hodge) did no good at all, though there was some uterine displacement that was corrected by this; but the advice of a leading obstetric physician to use a vaginal pessary containing bromide of potassium and atropine was at once followed by relief of all symptoms. We have had three cases of ovarian dropsy in Bethlem that I purpose in some future paper collecting and referring to; the only thing in common in their mental symptoms being distress and ideas of unworthiness.

Another patient, with a very large fibroid of the uterus, had ideas that she had been changed at birth.

Other cases that are at present under observation have markedly symptoms due to chronic uterine disease, but these cases are among the hardest one has to treat, for in one associated with constant bearing down pains and discharge of blood and matter there are ideas that she is nightly assaulted, that syphilis has been given to her, and that all sorts of poisons are administered. Any attempts at examining her

are strongly resisted, and chloroform is one of her insane dreads: as she fancies it is constantly being given to her for felonious purposes, we cannot use this to clear up our doubts and carefully investigate the case. This is less to be regretted, as the symptoms arose about the climacteric and she is now advancing in life.

Another case has a constant leucorrhœa, and all her ideas circle round marriage relationships, distrust of her husband, and thoughts that the doctors are going to marry her, or that those around her say, "She is no better than she should be," and otherwise take away her fair fame.

Here, again, we meet the objection to examination.

The misinterpretation of these uterine and ovarian irritations is seen, too, in many cases of puerperal insanity, some being erotic and given to masturbation, while others are given, like the lady with the large fibroid, to lose their own identity, or to mistake other persons.

In one case a patient who had had one previous child with the usual sickness of pregnancy, and became insane after the child's birth, when she became pregnant again and had severe vomiting she refused food, because she thought people were poisoning her and that the poison produced the vomiting.

Uterine irritation does not always act detrimentally. We had one patient who, after childbirth, was insane, and made no improvement till she had a large retro-uterine hæmatocele form, accompanied by great pain and vomiting. She began to improve at once, and was discharged at length well in mind and body, and has had a child since without any recurrence of the insanity.

The question of the unpardonable sin is in very many cases associated with irritation about the reproductive organs. My experience is that nearly all the young women with this idea masturbate; and in women about the climacteric, and widows, among whom this idea is also common, there is always more or less irritability, if not irritation.

The few facts I have placed together above are meant only to enforce the importance of investigating the condition of the genitalia in certain cases of insanity, recognising at the same time the difficulty or impossibility of doing this in some cases.

A CASE OF LARGE TUMOUR OF THE LEFT CEREBRAL HEMISPHERE, WITH REMARKABLE REMISSIONS IN THE SYMPTOMS.

BY J. BURNEY YEO, M.D., F.R.C.P.,

Physician to King's College Hospital.

IN the middle of June 1877, a lady, fifty-nine years of age, came under my care, complaining of the following symptoms: general loss of power, especially of the lower half of the body, her right lower limb being chiefly affected; the right foot was lifted from the ground slowly and with difficulty, and the toe dragged in walking. The upper part of the body showed no very appreciable muscular paralysis, although the grasp of the right hand was a little weaker than that of the left, and sensibility all over the right side was undoubtedly diminished.

The patient's mental faculties, which were usually bright and active, and accompanied with much facility in expressing her ideas, were decidedly obscured, and she had great difficulty in finding words to express the simplest ideas. She was much distressed by this difficulty in finding words. She could not write a letter; not only had she difficulty in managing her pen from loss of sensibility in the hand, but she obviously could not command words, and her attempts resulted in an incoherent scrawl, in which a few words only could be recognised.

Her memory was greatly impaired, and although she would attend to and take an interest in what was read to her, she would almost immediately forget it, and take the same interest in its repetition. She appeared capable of recognising external objects, but failed in any close attention to them: *e.g.*, when asked if she could tell the time by a watch, she would say, "Oh yes, very well;" and then when a large watch was presented to her, after looking at it for a moment or two, she would put her hand to her head, and simply look distressed. At this period there was very little complaint of headache or of sickness.

I obtained the following history of her illness from her friends:—She had left England about three months before in fair health, to visit some relatives in the east of Europe; and it was during the homeward journey, after a successful tour, that the first symptoms of her illness appeared. The earliest sign noticed was in a letter received by one of her relatives, written at Malta, which was a little incoherent and badly expressed, and contrasted strongly with her usually carefully written and well-expressed letters. At Gibraltar, after a long walk, she appears to have been attacked with partial hemiplegia, for she was found sitting on the floor in her dressing-room, and it was then particularly noticed that she found much difficulty in finding words, and that her memory had become very defective.

She appears to have recovered partially from this incomplete hemiplegia, but there continued to be much loss of power about the lower part of the trunk, and she remained during the rest of the homeward journey much in the same condition as when I saw her in June, immediately after her arrival.

For a few days after my first visit she continued to be tolerably cheerful, and appeared to take an interest in things around her, and conversed with her relatives and friends; but an attempt to drive in the open air was followed by complaint of severe pain in the head, and the next day a state of complete mental apathy came on, from which it was impossible to rouse her to take an interest in anything. She lay with her eyes closed, pupils equal and sensitive, breathing slowly but regularly, with a good, steady pulse, and taking small quantities of food mechanically. She remained in this low and apathetic state for about a fortnight, giving rise to much anxiety whether she would ever rally from it; when, on the arrival of her son from abroad, she quite suddenly recovered her mental activity and a considerable amount of muscular power. She conversed intelligently, took an interest in what was passing around her, asked questions, and appeared to recover her memory to a great extent, sat up on the sofa, and was able to use her right hand, as well as the left, to some degree. But there was not much recovery of power below the waist.

Soon after this remarkable rally some fresh symptoms made their appearance, viz. severe pains in the head, especially referred to the left side and back of the head, and troublesome vomiting.

I may mention here that croton (butyl) chloral certainly relieved the pain in the head, in from two to six grain doses. Both the vomiting and the headache were greatly relieved by

appropriate treatment, and the mental condition was remarkably influenced all through the illness by the action of the bowels. After free alvine evacuations there was always noticed a decided improvement in the mental state.

This first rally lasted between two and three weeks, when she again passed into a state of complete mental apathy, with apparently general loss of muscular power, as on the former occasion. This lasted about ten days, when another and still more remarkable rally occurred. She sat up on the sofa, would even attempt to get off it, conversed cheerfully and collectedly, was able to take a sort of retrospect of her illness, could use both hands sufficiently well to do a little knitting, took food with relish, had no pain in the head, and no vomiting. This singular improvement, which excited in her relatives and friends much hope of ultimate recovery, continued for nearly three weeks. She then again, and for the third time, somewhat suddenly passed into a state of mental obscuraton, not so complete as on the former occasions; but now a curious restlessness affected the right side—the side on which the loss of power had been especially observed—the right hand and arm would be constantly making purposeless movements, and the right leg first flexed and then extended. From this recurrence of the phenomena there was never again a complete rallying as on the former occasions. There was progressive loss of muscular power, but occasional partial recovery of mental activity. About the end of September the loss of power was so general that she was obliged to keep her bed, having up to this time been dressed and moved to a couch in a sitting-room almost daily. Extensive bed-sores formed very rapidly, and were attended by a low sub-pyrexial state, from which she sank on the 14th of October, just four months after I first saw her, and about five months from the appearance of the first symptoms.

A post-mortem examination of the brain was permitted, but it had to be performed hastily, and under difficulties which precluded the possibility of a detailed examination of that organ being made.

The posterior part of the left hemisphere was greatly increased in size, and prominently bulged by the existence within its substance of a large oblong tumour (having the microscopical characters of glioma), about the size of a goose's egg, or rather larger, and weighing nearly six ounces. It did not extend beyond the posterior half of the hemisphere; it was situated chiefly in the white substance of the posterior lobe, and quite centrally. It did not extend to the upper surface so as to reach the convolutions, nor to the inferior or inner surface, so as to interfere with any of the structures at the base of the

brain, or in the floor of the ventricles. But owing to the greatly increased size of the left hemisphere, the structures at the base of the brain were curiously altered in position; one half, the left, being, as it were, pushed forward, so that parts which should have appeared horizontal (*e.g.* the optic commissure) had an oblique direction. I had the advantage during the course of the illness of the co-operation of Sir Wm. Gull and Dr. Hughlings-Jackson. During the early part of the illness we hesitated somewhat in expressing a positive opinion as to the precise nature of the disease; we were soon, however, convinced that we had to do with a case of cerebral tumour. The discovery on ophthalmoscopic examination of double optic neuritis confirmed our opinion. We were enabled also to trace in the family history evidence of the existence of a tendency to malignant disease.

The most remarkable feature in the course of this case was the several decided rallies to which I have called attention. The improvement was on the two first occasions so striking, and on the second occasion so long maintained, that it was with difficulty we could persuade the patient's relatives and friends that we had before us a case of inevitably fatal disease. The *central* position of the morbid growth will no doubt help to account for this, as it will also account for the absence of complete hemiplegia, of any local paralysis, of convulsions, and of delirium.

Abstracts of British and Foreign Journals.

The Brain and Cervical Nerves of the Manatee.—The Brain of the Manatee (*Manatus Americanus*) has been lately described by Professor Garrod, at p. 142 of vol. x. of the *Transactions of the Zoological Society*, and illustrated by a plate (Pl. XXX.) of four lithographic figures. Dr. Murie had previously described and figured this organ in his splendid monograph upon the Manatee (*Trans. Zool. Soc.*, vol. viii. 1872), but the specimen was not in the best condition for investigation. Dr. Garrod was fortunately enabled to remove the brain of the Manatee which he dissected within twenty-four hours after death. There are no convolutions “properly so called.” The Sylvian fissure is large, and bifurcates high up. A hippocampal sulcus gives origin to a hippocampus major, and the calloso-marginal furrow is well marked. The corpus callosum is short, and the anterior commissure small. There is, finally, no posterior horn to the lateral ventricle.

Dr. Murie states in his monograph, that in the specimen dissected by him there were eight pairs of cervical nerves, of which two pairs issued between the second and third cervical vertebrae. Hence he is led to infer that the presence of only six cervical vertebrae in the Manatee’s neck is to be explained by the supposition that the third cervical vertebra is suppressed, leaving the two pairs of cervical nerves behind it—the third and fourth respectively—unrepresented by a vertebra. Professor Van Beneden, of Liège, found, however, on dissecting a Manatee in Brazil, subsequent to the publication of Dr. Murie’s paper, that there was only one pair of cervical nerves in the position indicated. Quite recently, too, Professor Ray-Lankester fulfilled a particular request of the Liège Professor, in making a careful dissection of the cervical region of the Manatee in the hands of Professor Garrod, and found the following arrangement of cervical nerves:—A single pair of nerves issues between the occiput and atlas, a single pair between the atlas

and axis, a single pair between the latter and the third vertebra, and again a single pair between the third and fourth vertebrae, and so on for the interspaces between the fourth and fifth, fifth and sixth, and the sixth cervical and first dorsal vertebrae. The third pair of cervical nerves is certainly much larger near its origin than is either the first or second nerve; but the most marked increase in bulk is to be seen in the fourth pair, which issues between the third and fourth cervical vertebrae. There was, finally, no trace of any additional nerve, or of any structure which could be taken for such a nerve, in the interspace between the second and third cervical vertebrae. The third cervical nerve is connected with the fourth by a slip, and furnishes through this the highest origin for the phrenic nerve. All the nerves were most carefully traced to their origin in the medulla.

The Brain of the Chinese Water Deer.—Professor Garrod, in some 'Notes on the Anatomy of the Chinese Water Deer (*Hydropotes inermis*),' published in the *Proceedings of the Zoological Society* for 1877, gives a figure, accompanied, at p. 791, by a short description of the brain of this ruminant. This organ is stated to be much like that of the Pudu Deer (*Cervus pudu*), already described and figured by Professor Flower (*Proc. Zool. Soc.*, 1875, p. 177), differing mainly from it in that the hippocampal gyrus is much less conspicuous upon the superior aspect. It is much more convoluted than the brain of the Musk-deer (*Moschus moschiferus*), *ibid.* figs. 11–13, upon the typical ruminant pattern.

The Brain of the Three-banded Armadillo.—In the first part of the *Proceedings of the Zoological Society*, for 1878, Professor Garrod describes (p. 226) and gives four figures of the brain of *Tolypeutes tricinctus*, one of the genera of three-banded armadillos. As yet the brain of no kind of *Tolypeutes* had been described, for in the specimen which formed the subject of Dr. Murie's most elaborate monograph upon *Tolypeutes conurus*, in the *Transactions of the Zoological Society*, vol. xxx., this organ had met with an accident. Professor Gervais, in his 'Mémoire sur les Formes cérébrales propres aux Édentés vivants et fossiles' (*Nouvelles Archives du Muséum*, tom. v.), gives a figure (Pl. II., fig. 8) of a cast of the interior of the skull of this armadillo, but this can afford at the best but meagre and somewhat conjectural information. The brain of *Tolypeutes* differs but little in general appearance from that of *Dasypus sexcinctus*, the six-banded armadillo, described and figured by Professor Turner in the *Journal of Anatomy and Physiology*, vol. i., 1st series, p. 313, 1867; but in surface markings it more

closely resembles the brain of *Tatusia peba*, as figured by Rapp in his well-known monograph—'Anatomische Untersuchungen über die Edentaten,' 2te Aufl., Taf. VIII., Fig. 3: Tübingen, 1852. The Sylvian fissure is only represented by an open and shallow angle. The olfactory lobes are very large and broad. On the surface of each hemisphere are two sulci—one anterior and horizontal, dividing the frontal region into two parts, while the other fissure runs longitudinally. The corpus callosum is short, while the anterior commissure is well developed.

At p. 229 of the same paper, Professor Garrod gives a figure of the upper surface of the brain of a specimen of *Xenurus uncinatus*. This is intermediate in form and surface markings between that of *Dasyurus* and the brain of *Tolypeutes*.

The Brain of the Echidna.—In the Atlas accompanying a recent number of Professor Gervais' 'Ostéographie des Monotrèmes vivants et fossiles,' there is given (Pl. VII., fig. 3) a figure of a cast of the interior of the cranium of one of the families of Echidna, *Acanthoglossus Bruinii*. The convolutions appear to be very numerous and complex, the frontal region, moreover, being especially well developed. Curiously enough, in the only other genus of the Monotremata, namely, *Ornithorhynchus*, the cerebrum is, as described by Meckel in his well-known monograph—"Vix gyris sulcisque excepto in cerebello, notatum." J. C. GALTON.

On the White Tracts of the Spinal Cord. By J. M. PRESTON, M.D. *Dublin Journal of Medical Science*, May and June 1878.—After showing the very scanty amount of information which can be gained by examination of the fully developed cord, as to the origin, course, and destination of the white fibres, a sketch is given of the principal results which have been obtained by Flechsig from a study of the development of the central nervous system.

Seven separate tracts of white matter may be distinguished in the spinal cord by their successive development. These are, in the order of their formation: (1) Fundamental tract of anterior column; (2) Fasciculus cuneatus (Burdach); (3) Anterior mixed tract of lateral column; (4) Lateral bordering layer of grey substance; (5) Goll's column; (6) Direct cerebellar tract; (7) Pyramidal tracts. The first four of these are commissural between different portions of the cord. The number of fibres in each tract varies at each part of the cord according to the amount of grey matter present and to the size of the nerve-roots entering that region. The three last tracts, on the other hand, increase steadily in size from below upwards, and are absent altogether in the most inferior

portions of the cord. Their fibres serve to connect the different regions of the cord with the brain; the pyramidal tracts with the cerebrum and basal ganglia, the cerebellar tracts with the cerebellum, and Goll's column with the medulla oblongata.

Some of the fibres of the pyramidal tracts of each side would appear to arise in the motor regions of the cerebral cortex, others in the basal ganglia. They run in the lower portion of the crus cerebri, and in the anterior pyramid of the same side; they partially decussate at the lower part of the medulla oblongata, and are continued in the cord, partly in the posterior part of the opposite lateral column, partly in the inner part of the anterior column of the same side. Inferiorly they would seem to enter the grey matter and become connected with the large branching cells of the anterior horn. The extent to which the pyramids decussate is very variable. Sometimes the whole pyramid passes to the opposite side; sometimes the greater part remains uncrossed in the anterior column of the same side; and frequently one pyramid decussates to a much greater extent than the other. But this rule is invariable: supposing the anterior pyramids of the medulla oblongata to be of equal size, which is usually the case, the left anterior and right lateral pyramidal tracts are equal to the right anterior and left lateral tracts. This rule proves that the pyramidal tracts grow downwards from the brain, a mode of development which is corroborated by several other circumstances.

The cerebellar tracts arise in the cord from the cells of Clarke's posterior vesicular columns, and pass upwards in the outer and posterior part of the lateral columns, and, without decussating, run in the inferior cerebellar peduncles to the cerebellum of the same side, where their termination is unknown.

The connections of Goll's columns in the cord have not as yet been made out. Superiorly they do not decussate, but terminate in, or at least are interrupted by, the post-pyramidal nuclei of the medulla oblongata.

The facts of secondary degeneration of the cord in cases of disease or injury (whether accidental or experimental) agree in a remarkable degree with those of development.

The vivisections recently performed in Ludwig's laboratory show that the greater number of the fibres which connect far-distant parts of the nervous centres with one another, run in the lateral columns of the cord, and that each half of the cord contains both centrifugal and centripetal fibres from both sides of the body, but that, while the centripetal fibres for the most part decussate in the cord, the

greater number of the centrifugal conductors run a direct course and decussate higher up. The hyperæsthesia which follows certain lesions of the cord depends probably on destruction of inhibitory fibres.

Finally, it is shown that the diseases of the different tracts of white matter in the cord throw but little light on its anatomy or physiology.

J. CRIGHTON-BROWNE.

Report on Visceral Neurology. By J. MITCHELL BRUCE, M.D., F.R.C.P.—*Innervation of the Heart.*—An exceedingly important point with respect to the inhibiting apparatus of the heart has been demonstrated by Professor Arthur Gamgee and Mr. Priestley (*Journal of Physiology*, i. 39). They have found that the enduring power, or resistance to fatigue by faradaic stimulation, of the inhibiting apparatus that is intermediate between the vagi and the cardiac ganglia, is incomparably higher than the enduring power of the vagi. The intermediate apparatus can be stimulated (stand-still induced of the heart) by direct application of the electrodes to the *sinus venosus*, after prolonged faradization of the vagi has ceased to have any effect upon the movements; that is, after complete exhaustion of the vagi-trunks. Another point brought out by the same experiments is that the inhibiting intermediate apparatus in the heart, both of mammals and of the frog, is single, and not double to correspond with the two vagi nerves. Professor Gamgee and Mr. Priestley have shown that M. Tarchanoff's conclusions that the inhibiting apparatus is double in the frog are certainly erroneous.

The question of the situation of the ganglia in the heart of the frog has again been taken up by Professor Bowditch, of Harvard University. He has repeated with various modifications the experiments of himself, Merunowicz, and Bernstein, upon the automatic action of the apex of the ventricle, and has arrived at the conclusion that the apex of the frog's heart does not contain within itself the conditions for automatic motion; and that when, after transverse compression of the ventricle, the apex, at first brought to rest, recommences to beat, this renewal of activity depends upon the restoration of an imperfectly destroyed connection between the apex and the motor apparatus at the base of the heart (*Journal of Physiology*, i. 107).

Depressor Nerve.—Kreidmann believes that he has discovered anatomically the depressor nerve in man and in the dog, where hitherto they have not been found. (*Centralblatt f. med. Wiss.* 1878, No. 11, p. 193.) His description of the nerve that he believes to be the depressor nerve in man is as follows:—The vagus in man forms within its sheath no united whole, but is composed of several

branches. From the *inner* branch there springs the superior laryngeal nerve; this gives off a nerve downwards, which is sometimes thicker, sometimes finer, and derives in its course a twig of variable thickness from the *vagus*. After an independent course of 2-3 centimètres, it blends with the *inner* branch of the *vagus*. This nerve, therefore, closely resembles anatomically the depressor nerve of animals, excepting that it does not pursue an independent course in the neck, but lies in the sheath of the *vagus*.

Innervation of the Blood-vessels.—Vasor centres, and vaso-motor and vaso-dilator nerves, are the subject of many important contributions to physiology and pathology during the last few months. The question of peripheral vasor centres, independent so far of the centres in the cord and brain, has especially received attention. Thus Professor Stricker tries to explain the return of tonus in vessels of the lower extremities that have been dilated by section of the cord by "collateral innervation." He believes that vasor fibres leave the cord at a level above the section, and reach the sciatic nerves through the trunk of the sympathetic. Fresh section of the cord above this level will produce fresh paralysis of the vessels; and section of the sciatics will be followed by the same effect. (*Centralblatt f. med. Wiss.* 1878, No. 3, p. 51.) Gergens and Werber describe the results of experiments which are in favour of the existence of peripheral vasor nerve-mechanisms. The oedema and loss of vascular tone in a pithed frog are found to become decidedly less after twenty-four hours, if the animal be kept in a horizontal position—the heart is again filled, and there is partial recovery of vascular tone. Independent vascular contraction and dilatation can also be seen in pithed frogs, on the application of cold or of chemical stimulants. (*Centralblatt f. med. Wiss.* 1878, No. 6, p. 111.) All attempts to discover a nervous mechanism in the vessel-walls have, however, been unsuccessful. Frey (*Centralblatt f. med. Wiss.* 1878, No. 11, p. 198) supposes that the vaso-constrictor and the vaso-depressor nerves end together in ganglion-cells which lie in the vessel-wall, and that they stand to each other in a simply antagonistic relation. He believes that he has proved this by the results obtained from the simultaneous galvanization of the chorda tympani and sympathetic nerves of the submaxillary gland, while the quantity of blood flowing from one of the larger veins of the gland was carefully measured.

The *accommodation* of the blood-vessels to the quantity of blood within them has long been referred to a nervous mechanism. It is a familiar fact that the general blood-pressure may suffer

little from local vascular disturbance, whether of the nature of contraction or of dilatation; that the intra-vascular injection of blood does not markedly raise the blood-pressure if the vaso-motor centre be intact; and that venesection does not permanently reduce the pressure until as much as 3 per cent. of the body-weight in blood has been removed from the circulation. Pawlow of St. Petersburg has lately made certain investigations to demonstrate the mechanism of this accommodation (*Pflüger's Archiv*, xvi. 4 and 5, p. 266, January 1878). He caused the abdominal veins of a rabbit to become dilated by exposing a loop of intestine, and he then watched the vessels of the ear. These vessels were found to contract. If the cervical sympathetic of one side were previously cut and the same experiment performed, the auricular vessels were seen to contract upon the intact side only—an observation which proves that paralysis of the vaso-motor nerves of the part interfered with the vascular accommodation. The mechanism of accommodation was therefore nervous. We may conclude that just as irritation of the skin causes paralysis of the cutaneous vessels and contraction of visceral vessels, so irritation and dilatation of the visceral vessels lead to contraction of the vessels in other parts of the system; and that it is by this means that the vascular system is accommodated to local alterations on pressure. Accommodation to changes in the amount of blood in the whole circulation must similarly have a nervous mechanism. The physiology of the vaso-motor nerves of striated muscles, and the wider question of the effect of the stimulation of sensory nerves upon the vessels of the same and of other parts of the body, as well as upon the general blood-pressure, are the subject of several important papers by Heidenhain and his pupils, and by Mr. Gaskell (*Pflüger's Archiv*, Bd. 16, p. 1, and *Journal of Physiology*, i. p. 108). The results arrived at are still too uncertain to require notice from us.

The Nervous Mechanism of Respiration.—It has long been a matter of dispute whether amongst the many and complex functions of the vagus in respiration, the innervation of the bronchial muscles should be included. Gerlach (*Centralblatt f. med. Wiss.* 1878, No. 6, p. 105) has investigated the subject experimentally. By attaching a manometer to the trachea close above the bifurcation, he found that faradization of the peripheral end of the vagus in the neck caused a rise of pressure, which was proved by the careful elimination of other causes to be due to contraction of the muscles of the smallest and middle-sized bronchi. Similar results were obtained reflexly, when one vagus was left entire and faradization applied

to the central end of the opposite vagus, or to the central end of the superior laryngeal, but not by irritation of the central end of the recurrent laryngeal. Gerlach has reason to believe that the innervation of the bronchial muscles is not direct from the vagus, but effected through ganglia, as in the stomach and intestine; and that peristaltic movements may occur in the finer bronchia. Zuczek furnishes a very interesting clinical confirmation of the correctness of this view (*Centralblatt f. med. Wiss.* 1878, No. 14, p. 256) in a case where a bronchial gland was diagnosed to be pressing upon the vagus in the chest. A man suffering from chronic apical pneumonia was seized with palpitation of the heart, faintness, and a sense of oppression, the pulse rising to more than 200. Soon after the diaphragm ceased to contract, while the upper ribs acted vigorously, and the area of pulmonary resonance was markedly increased. The heart and lungs rather suddenly returned to their normal state after a period of twenty-four hours. As no other possible cause could be discovered, Zuczek concludes that the pulmonary branches in the vagus were irritated, while the cardiac branches were probably paralysed, by an enlarged bronchial gland.

Neurology of the Sympathetic.—A series of cases in which phenomena connected with the sympathetic in the neck were observed by Seeligmüller (*Centralblatt f. med. Wiss.* 1878, No. 1, p. 12), suggests the belief that similar results might be more frequently obtained clinically if they were more carefully searched for. Thus in a child whose left brachial plexus had been paralysed *inter partum*, Seeligmüller found that the left pupil was but half the size of the right; that the corresponding palpebral fissure was small; and that eruptions occupied the left half of the body only. Somewhat similar results followed a gunshot wound in a man through the apex of the left lung; while in a third and in a fourth case signs of irritation of the left cervical sympathetic were observed after injury to the brachial plexus. Seeligmüller is convinced, indeed, that many affections of the apices of the lungs, and even of inflammation of the deeper parts of the lungs, may excite phenomena connected with the sympathetic in the neck.

The circulation within the skull can, according to Fischer (*Centralblatt f. med. Wiss.* 1878, No. 7, p. 124) be influenced by "galvanization of the neck." He will not call the method "galvanization of the sympathetic," believing, as he does, that the ends of the sensory nerves and the different fibres of the vagus are irritated, the latter most powerfully affecting the brain, while the sympathetic contributes but little to the result.

"*Trophic Nerves.*"—Two cases illustrative of the relation between the nutrition of the viscera and muscles and the condition of the central nervous system deserve to be noticed. The first case is published by Kirnberger (*Centralblatt f. med. Wiss.* 1878, No. 3, p. 61). A man of fifty-one fell on the back of his head, and made an impression as large as half-a-crown upon the right occipital and parietal bones. He remained unconscious for twenty-four hours, after which time he presented loss of sight and smell, paresis of the left extremities, and a normal condition of urine. Recovery was slow, but complete. Two years and a half afterwards, however, visceral symptoms made their appearance—the heart became enlarged with a systolic murmur at the left apex, the liver increased in size, the urine was abundant, and contained about $\frac{1}{2}$ per cent. of sugar, an increasing amount of albumen, and casts; there was frequent intestinal hæmorrhage; and nutrition generally was impaired. *Post mortem* a fissure was found to extend downwards and to the left from the seat of injury, with spots of caries; there was chronic pachymeningitis; and several old apoplectic foci were discovered throughout the brain, namely, one in the right posterior lobe, a smaller in the left posterior lobe, a third at the base of the middle lobe near the Sylvian fissure, and a fourth and a fifth on the anterior frontal lobes corresponding to the olfactory bulbs. The heart was large and fatty, the liver was firm, the pancreas was slightly fatty, as were also the kidneys, and the mucous membrane of the intestines was sound.

The second case was one of softening of the cord three years after injury to the left shoulder and loins, which had left permanent uselessness of the left arm. *Post mortem* the dura mater was found firmly adherent to the vertebræ from the third to the tenth dorsal. At the cervical enlargement there was extensive softening of the nature of acute myelitis, both grey and white matter being involved. Exquisite interstitial myositis was found in the muscles of the left arm, while the muscles of the lower extremities were simply atrophied (Leyden, *Centralblatt f. med. Wiss.* 1878, No. 16, p. 295).

Buzzard on Blepharospasm.—Dr. Buzzard (*Practitioner*, June 1878) succinctly narrates a case of left-sided blepharospasm, of two months' duration, the course of which was not apparent until special investigation was made for pressure-points. The patient was a healthy man, of 53 years of age. One evening, about two months before Dr. Buzzard saw him, the patient suddenly felt a twitching in the left eyelids, which was accompanied by what he called a "numbing feel" about the left temple and ear. The next morning, as soon as he began to eat his break-

fast, he got repeated spasmodic closure of his left eye, accompanied by a sensation of dragging in the neighbourhood. Whenever he began to talk or to eat, or if he got excited, there came a rapid succession of forcible closures of his eye for a few seconds. Dr. Buzzard found that when firm pressure was made upon the tragus and also on the skin for about an inch in front of it, the spasm ceased, but recurred on removal of the pressure, and was apparently more violent. The patient could hear Galton's whistle 8° with his right ear, but only 5° with the left; there was an abnormal sensation in the left ear—not "singing." A large quantity of wax was removed from the left ear by syringing; but this did not appreciably diminish the spasm. A daily application of the constant current for ten minutes—one rheophore being placed in front of the tragus and the other behind the outer canthus—and a blister behind the ear, removed the spasm in a few days, leaving only a trifling flickering of the lids like that called live blood. We learn that there has been no relapse two months since treatment was given up.

Dr. Buzzard remarks that we largely owe to Von Graefe the indications to be derived from "pressure-points," and gives illustrations of the value of the test. Amongst them was a hospital patient with obstinate blepharospasm, in whom Mr. Brudenell Carter, to whom he sent her, divided both subcutaneous maxillary nerves, finding that pressure on the cheekbones temporarily checked the spasm. This was done, with instant relief, two years ago, and the patient remains almost free from spasm. In other instances the seat of irritation (as indicated by the effect of pressure) has been an ulcer of the palate, an adherent scar, a decayed tooth, or a branch of the fifth inflamed by cold. Dr. Buzzard suggests that in facial spasm, the source of irritation, which is often unfelt, may sometimes be also distant. He refers to a case of rhythmic movements of the shoulder which he could control by strong pressure in the left ovarian region, and there alone. In the present case he thinks that the auriculo-temporal division of the fifth was irritated (through the twigs which it sends to the meatus auditorius) by the hard mass of wax. Through its branches to the temporo-maxillary articulation, movements of the jaw in eating or talking caused an excitement, which, being propagated to a reflex centre in the medulla or (possibly) in the otic ganglion, occasioned spasm of certain muscles supplied by the portio dura, with which nerve the auriculo-temporal is in intimate relation.

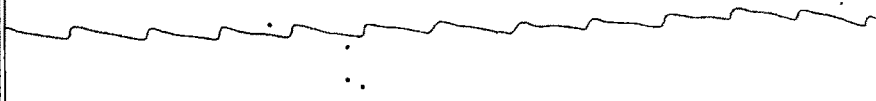
J. HUGHLINGS-JACKSON.

TYPE 1.



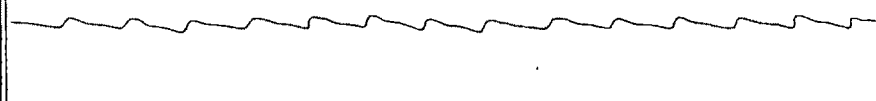
During a period of Comparative Quietude. Buoyant & Happy.
27th March. 77.

TYPE 1.



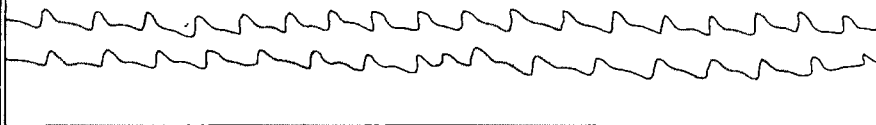
During period of quiet, succeeding period of acute delerium of several
days duration. Very sleepy. 14th Nov^r 77.

TYPE 1.



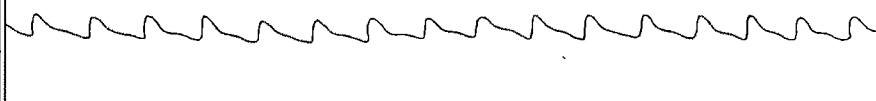
Quiet succeeding acute delirious excitement.
14th Nov^r 77.

TYPE 2.



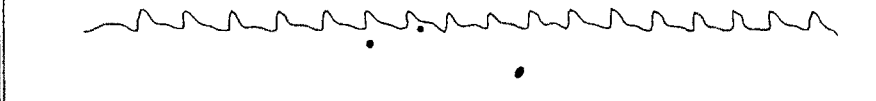
During period of low muttering delirium.
12th Nov^r 77.

TYPE 2.



During excited Paroxysm.
15th Oct^r 77.

TYPE 2.



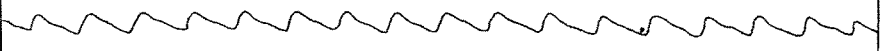
During excited Paroxysm.
15th Oct^r 77.

TYPE 3.



During Acute Delirious Excitement.
4th Decr 77.

TYPE 3.



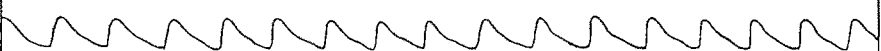
During Acute Delirious Excitement; Pupils unequal, Medium dilatation, Left slightly the larger. 30th Octr 77.

TYPE 3.



During Somnolence of Congestive attack.
20th Novr 77.

TYPE 3.



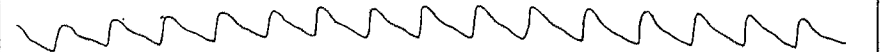
Acute Delirious Attack. with hallucinations of sight, Pupils slightly contracted, the left being the larger. 10th Novr 77.

TYPE 3.



Acute Delirious Attack, with hallucinations of sight, Pupils slightly contracted, the left being the larger. 19th Novr 77.

MIXED TYPE.



Acute Delirious Excitement.
30th Octr 77.

MIXED TYPE.



Quiet after attack of excitement. - Pupils dilated, the left being the larger.
22nd Octr 77.

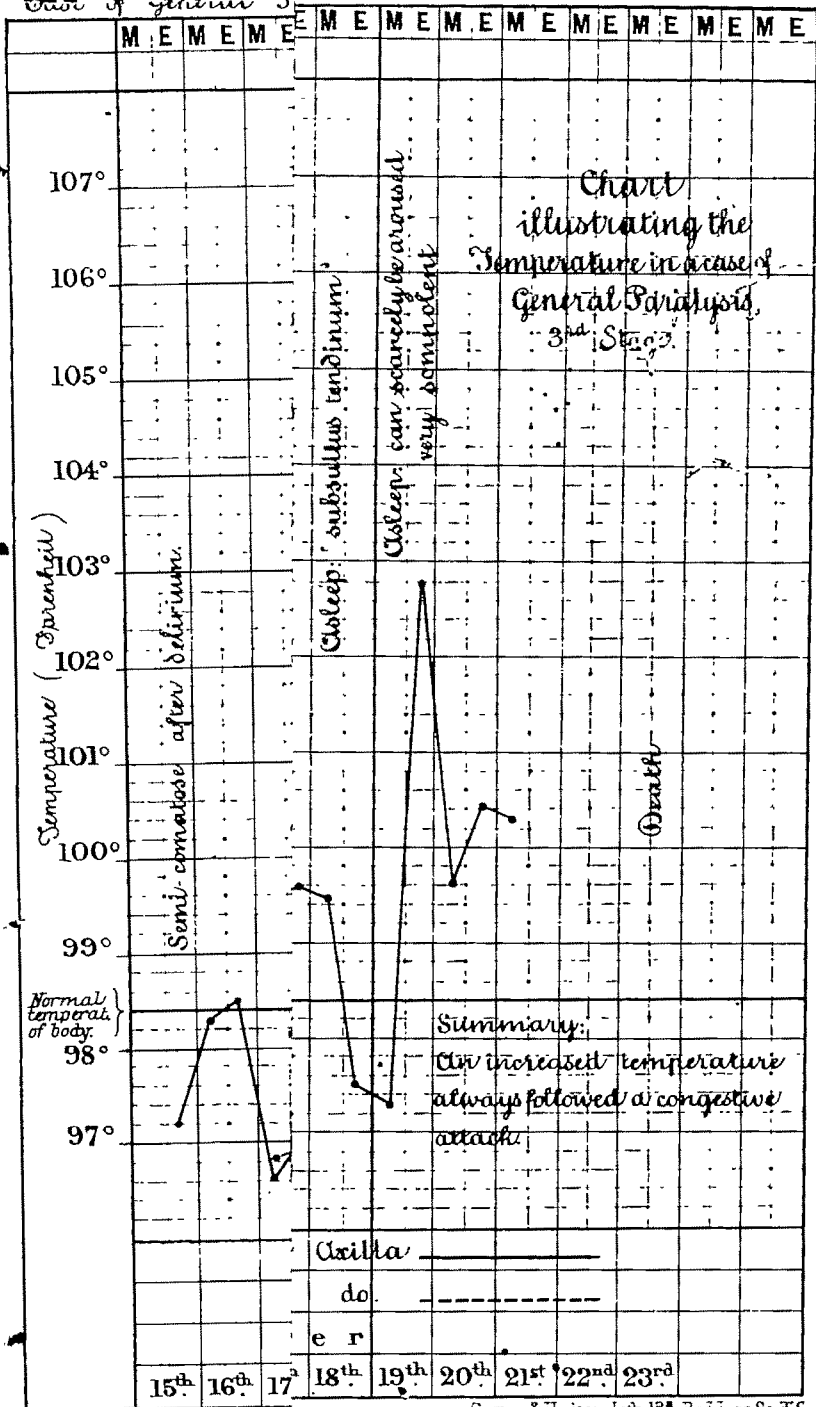


Chart
 shewing the
 nature, Pulse and Respirations
 intervals before during & after
 congestive attack (convulsions)

any
 congestive (convulsive) attack was
 preceded by a comatose condition, &
 characterised by a low temperature,
 pulse and impeded respiration
 (narrowed contraction).
 At the onset of the convulsions the
 temperature rose, and the respiration
 became more frequent.
 The temperature commenced to fall
 as the patient advanced towards
 recovery from the convulsions.

42

41

40

39

38

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SOME OF THE LESSONS OF NEUROTOMY.

BY S. WEIR MITCHELL, M.D.,

Of Philadelphia, Member of the National Academy of Sciences, U.S.A.

It is not very many years since all that we knew of nerve sections, and their results, could have been put into a very small space; but the increasing care with which the modern physician studies his cases has led in this, as in all directions, to novel and fast accumulating conclusions of the utmost practical value.

The sad opportunity of our late civil war afforded an unequalled chance to study this interesting subject, and a large experience has since added new opportunities. Out of this constant accumulation have come numerous essays, scattered here and there in journals, and embodying many facts of value which it is perhaps worth while now to bring together. Moreover, I have of late learned in regard to certain nerve sections a class of facts which, I believe, has hitherto altogether escaped notice. I shall deal, therefore, in this paper with the subject of neurotomy under two heads:—

1. The indications for nerve sections.
2. The consequences of nerve sections.

In discussing these subjects I shall of course avoid, as far as

possible, what is already old or commonplace medical knowledge, and shall dwell more largely on those points which are still novel, and many of which have neither found their way into the text books nor become familiar to the surgeon, as part of the light in which he should consider the propriety of a nerve section.

1. *Indications for Neurotomy.*

It becomes needful to discuss the question of a nerve section whenever a local irritation, either arising from disease¹ or from mechanical injury, gives rise to unmanageable peripheral symptoms (such as spasm, hyperalgesia, neuralgia), or to reflex neuroses of like nature affecting distant parts, or disturbing the circulation in the centres, as in the rare causation of vertigo.

Most of the questions which arise in this connection are easily answered; but there are certain points in regard to the various forms of pain which will bear some further examination, because their clinical history is such as to make it at times very difficult to decide for or against the operation of nerve section. Thus in the common case of neuralgia of the fifth nerve, we usually find the pain at first confined to a single branch of the nerve, and we have no evidence to make us sure that the cause of pain lies in the peripheral distribution of this branch. Indeed, we have as often reason to believe that it does not, and that the centre or the ganglion is at fault; but even when this is the case it is frequently clear that the peripheral expansion, owing to the state of the centre, has passed into a condition of hyperæsthesia, so that, whether or not the original cause lay in the surfaces, these have become secondarily the parents of pain, and in turn react on the sensitized centre. When, therefore, other means have been exhausted, I am frequently willing to cut a facial nerve branch, whether or not I am sure that the original cause of pain lies in the periphery. Later in the history of facial pain the matter is complicated by the spread of pain to other branches of the nerve; but even then, when I am clear as to

¹ Case of Section of Brachial Plexus, Dr. Maury, *Amer. J. Med. Sci.*, 1875.

the filaments in which it first appeared, I am willing to divide these filaments, and in my experience I find that I get, even under such circumstances, a fair percentage of success. The operation is here justified by experience—by the fact that the section in some way alters the central pain-making conditions; and lastly, because nerve sections in the face give rise to little inconvenience, and to none of the curious consequences which so often follow upon sections of the nerves of the hand. The question of the propagation of pain from branch to branch in a great nerve, is one to which I shall return at another place. I think we must concede, however, that this diffusion of pain is not always evidence of the increase or spread in the centres of an organic cause, but is due rather to what I might call, using a photographer's phrase, a *sensitizing* of the related ganglionic cells, so that in neuralgia, as in tetanus, the capacity to produce abnormal pain is capable of passing from cell to cell, and sometimes of thus affecting distant centres. Here at least, in a remarkable degree, pain is the parent of pain. In the extremities, and never, so far as I know, in the face, the propagation of pain is occasionally due to an ascending neuritis, resulting, in rare cases, in a form of sclerotic alteration in the nerves, the sheaths of which it reaches in its upward march.

I have reported elsewhere a remarkable example of this change, which I saw with Dr. Mears. I believe it less frequent than I once supposed it to be.

Among the most important matters to consider in regard to the propriety of a nerve section, is this very question of the possibility of organic change having extended up the nerve trunk. It is a grave question, because it is well for success in neurotomy to make the section above, or at all events near to, the limit of such change; and I have seen, over and over, failures on account of lack of care in this matter. In neuralgias without known cause the nerve is rarely visibly altered; but in the terrible traumatic neuralgias which fall on the hand, and usually on the median nerve, there is apt to be more or less extension of neuritis from the seat of injury. Save in very coarse changes, it is difficult to determine the state of the nerve at the time of

operation; and mere inspection is not enough, since even the most practised touch will fail to settle a question which only the microscope can decide.

If the change be slight, we can afford to wait, since cutting off the irritating region is then competent, in most cases, to put the nerve in a state of rest above the line of section; and when this result is attained, the organic changes gradually disappear. When, however, the sclerosis is notable, it rarely fades away, but seems to have acquired permanent power to propagate itself centrally.

I find that physicians are apt to believe that tenderness of a nerve-trunk above the point of irritation is a sign of organic change in the nerve; but this is by no means true. In the early stages of ascending neuritis the nerve is horribly tender, but in an advanced sclerosis the sensibility is not nearly so great. In the vast bulk of local nerve lesions of the hand there is, however, the most notable sensitiveness of the main trunk; in fact, there is always, after a time, in such cases, hyperalgesia, and this is of two degrees. In the lighter form the nerve-trunk is not remarkably tender, but pressure causes increased pain in the peripheral distribution in and beyond the point of traumatic disturbance. In the later and more severe form, pressure causes pain in the nerve itself, and also in the area of the neuralgia.

In these horrible traumatic neuralgias, electricity is of no value. Even when galvanism applied to the nerve-trunk has the curious ability to suspend, during passage of a current in either direction, the hyperalgesia of the painful areas, the current has no permanent therapeutic power. I mention the fact here, because we might naturally suppose that a current, which used on the nerve-trunk annihilates morbid sensation for the time, and enables us to touch the most sensitive regions without causing pain, would be certain to cure, if used assiduously. Yet such is not the case, and I have seen no good result in traumatic neuralgia from the most industrious use of electricity.

I am quite unable to say why galvanism possesses anæsthetic power in one of these cases, and not in another. I saw a few years ago two severe injuries of the median nerves in the same

part of the palm. In both, the fingers were painfully sensitive to the slightest touch. I galvanized three inches of the median above the wrist, using thirty cells. While the current passed, the analgesia of the fingers ceased to exist. I then reversed the current, which had been peripheral in direction, and was amazed to find the same result. Even twelve cells gave me the same effect, but an induction current was valueless. In the second case galvanism produced no good effect.

An excitable state of the main nerve-trunks in nerve wounds must be due to a propagation of sensitizing influences upward, or else to an acquired condition of the related centres.

The most startling sensitizing of a nerve, both motor and sensory, is obtained by chilling with a freezing mixture a limited portion until touch is lost, when the portion below becomes so excitable that the least tap over the main trunk causes motion of all the muscles which the nerve supplies, and also some pain, so that while tactile impressions do not pass the frozen part, those of pain do; showing, I think, as do many other facts, the distinctness of difference between the forms of nerve excitement which are caused by touch and by pain.

Since every nerve contains a certain number of recurrent fibres which find their way to the brain along trunks other than the trunk into which they primarily run,¹ it might have been expected that the nerves to which they finally convey impressions would share in the sensitiveness I have described. Thus the radial probably receives recurrent fibres from median nerve areas; but as yet I have been unable to find that the radial becomes sensitive when the median itself has been hurt. It certainly does not acquire such sensitiveness early, and I have doubts as to whether it ever does. Perhaps, since the recurrent nerve supply multiplies as we approach the periphery, the absence of the phenomenon in question may depend on the position of injuries which usually affect the palm. Lesions of the finger ends in the median areas would be more apt to give us sensitiveness in the radial trunk.

¹ 'Injuries of Nerves,' p. 60, S. Weir Mitchell.

2. Nerve sections, and their consequences.

The first question which arises when we have decided to resort to neurotomy, is one which at first glance it seems absurd to raise. It is, what nerve we shall cut. In the face, the answer is ready enough; but in the complicated distributions of nerves in the hand, it is not always so easy. The anatomists have somewhat misled us by their statements as to the innervation of fixed areas by certain nerves: whereas it is plain from the numerous cases of Letievant and myself, that it is to the clinical inquirer anatomy must look for a knowledge of surface-areas of nerve distribution, and that these areas differ widely in individuals. The uncertainty arises out of the curious variation of nerve supply to the hand. In some animals all the nerves but one may be cut without loss of sensation anywhere; and while in man this is by no means so completely or constantly true, case after case has been reported in which section of the median scarcely disturbed sensation.

How much of this preservation of sensation is due to anomalies, and how much to extreme differences in the amount of recurrent nerve supply, cannot as yet be known.

When a local injury falls on parts which are innervated by two nerves, or when it alights on the doubtful boundaries of two nerve-territories, there may be a good deal of reason to hesitate as to a nerve section.

The best means in these rare cases is to learn which of the main trunks is sensitive to pressure and to electricity, and how far benumbing pressure influences the morbid phenomena. But surgeons are rarely careful enough to make a thorough study of their cases, and I have several times known them to cut the wrong nerve. In one case, an injury of the palm caused epilepsy. The wound traversed the median and radial region. I found that pressure on the wound of entry (median) caused no result, while pressure on the wound of exit (radial) gave rise to violent fits. Section of the radial apparently cured the fits.

In another instance, a wound of the palm occasioned intense tenderness of the fore-finger and third finger, and also pain on

the back of the fore-finger. This latter induced the surgeon to try if pressure on the median and musculo-spiral would influence the pain. It gave rise to greatly increased suffering when applied to the former; but benumbing pressure by a tourniquet over the musculo-spiral not only annihilated the pain on the back of the fore-finger, but also in the median palm territory. He cut the musculo-spiral: the whole of the pain departed, only to come back within a week in a scarcely mitigated shape. The pain was relieved, as is pain in the infra-orbital nerve by removal of a sound tooth not in its territory. I cured the neuralgia by cutting the median. If, in this case, the surgeon had kept up the pressure on the median, by etherizing the patient so as to enable her to bear the force needed, he would not have made so grave a mistake. The tenderness of the median was in itself the true guide.

The operation of neurotomy is a simple one; but, as its object is to secure the permanent cutting off of a region of disease, the main point is to make sure that the excised portion of nerve shall not renew itself. I do not yet know how this is to be done; and, after a long and large experience, I find that the capacity of nerves to remake their lost parts is almost invincible, and is the true cause of many of our failures to attain permanently the object in view—the relief of pain.

If the pain recurs within five months, it is likely that the cause lies in more than one nerve, or that the trouble is, or has become, a central one. Nearly always a section gives relief for a time. If, at the close of five months, the areas cut off begin to be sensitive, and to regain *surface sensibility to touch*, the lost nerve-tissue is being remade; and if, after a time, electricity—interrupted or reversed, galvanic or faradaic—applied above the line of section causes motion in the muscles cut off by the neurotomy, it is of course put beyond doubt that the nerve has been yet more thoroughly restored. The return of function is always in this order: sensation first, motion last. I have tried many devices to prevent reunion, but none have answered. Doubling the lower end of the cut nerve, turning the ends aside, imbedding one or both in other tissues—one and all fail. The length of nerve removed has been supposed to be the most efficient factor in retarding or

preventing reunion; but we need a careful study of this matter in animals to tell us to what extent separation of the nerve ends puts off the date of return of function, since there is some reason to suspect that mere section is as efficient as exsections which remove less than two inches. I mention it as a partly open question.

In the cases of secondary section, where the lower end of the cut median had been doubled on itself, reunion took place in eighteen months, and I could not distinguish the doubling in the large button formed, and out of which ran the delicate connecting filaments. One plan yet remains for trial, and that is, to divide the nerve and draw the ends past one another. This plan I am about to test in the dog, but I do not feel any confidence that it will succeed in preventing reunion.

To my mind, nothing is more strange than the bewildering certainty with which these nerve ends, however dealt with, succeed in threading the tissues between and reuniting.

The rate and sureness with which this process occurs is inversely as the age. Dr. Hodge's case of reunion of the radial is, I think, the briefest in time. Two inches of the nerve were removed.¹ In six weeks pain returned—a sign of little value for reunion if it stand alone; but in nine or ten weeks tactile sensibility came back. Within eleven months the nerve was cut a second time, and found to have been thoroughly remade.

The indication then is, in every case to take away as much of the nerve as possible, avoiding as far as may be sections which involve motor nerves.

The consequences of neural resections vary somewhat with the nerve on which we operate, since, as I have already said, it is exceptionally rare to see nutritive disturbances in facial neurotomies, and common to observe them in the hand.

The first result of a nerve section is the almost sure relief of the neural pain. This consequence may be temporary or permanent; and it may be delayed for a brief period, and then be gradual and more or less complete, these variations depending on causes already discussed. 2. The temperature rises in the area of distribution of the nerve, and in the course of months falls below the normal standard. I first showed

¹ Neurotomy, S. Weir Mitchell, *Amer. J. Med. Sci.*, April 1876.

this in regard to the nerves of the hand, and have over and over seen it illustrated in later cases. Whether it be true or not of the facial nerves I do not know, but shall learn on the earliest occasion. The proportion of vaso-motor nerves which reach a given area of face or hand by the nerve tracks of sensation, by the vessels and otherwise, may vary so as to efficiently affect the thermal phenomena, which follow nerve sections.

Nutritive alterations in the skin, nails, hairs, areolar tissues, and muscles, follow in a certain proportion of nerve sections. I have never seen any of these disorders after section of any branch of the fifth nerve. They are more common after resection of nerves which supply the feet. In the hand they are rarely seen when the radial has been cut, not often after ulnar section, but more often after divisions of the median nerve.

The favourite theory, that the parts rendered insensible are thereby exposed to mechanical lesions, does not answer to explain these facts, since they occur unequally in different nerves, and are seen in parts which have been zealously protected from harm.

Moreover, they seem to contradict the law of Brown-Séquard which has been so generally accepted, to wit, that partial or irritative lesions give rise to trophic changes, and that paralytic lesions occasion only such results as are due to prolonged inaction. This principle is commented upon with approval by Charcot in his recent lectures (*Syd. Trans.* p. 19), where he puts it in the following very distinct form: "At the outset I shall establish what I consider to be a fundamental distinction between these traumatic lesions of nerves: 1. The lesion sometimes consists of a clean and complete section, in which case the effects are merely, speaking generally, those resulting from the absence of nerve action; 2. Sometimes, owing to contused or lacerated wounds, the lesion is of such a nature as to set up irritation in the nerve, in which case, and then only, we see arise those trophical troubles to which I invite your attention. The disorders, following irritative (partial nerve lesions) are, affection of the skin, bones, joints, nails, hair, and *rapid* muscular atrophy."

"It may also be added (p. 37, note), that irritative lesions of muscles have been of late recorded by competent observers as following section or excision of mixed or purely motor-nerves."

These troubles were, however, limited to muscles and their connective tissues; and so far, with the above exception, no one seems to have dwelt on the possibility of the same kind of lesions following complete sections as follow those which are partial, and therefore presumably irritative.

Until recently I have myself admitted the correctness of Brown-Séquard's law, and for many nerves, as, for example, those of the face, we may still adhere to it; but as regards the hand nerves, and especially the median nerve, I shall now have occasion to prove that irritative trophic lesions are sometimes seen after entire section, and that, in a certain proportion of cases, complete section after irritation appears to give rise to, or permit the continuance of, somewhat anomalous forms of pain in the peripheral distribution of the cut nerve.

Section of median nerve at wrist by glass wound: healthy man, æt. 47; no history of syphilis; entire absence of sensation in median territory. From the eighth week frequent bullæ, followed by ulcers of the palmar face of the fore and middle finger; thickening and considerable enlargement of middle finger. The appearance of the ulcers, which when I saw him were numerous, was very singular. They resembled deep holes, cut out by a punch, and were almost dry, having, in fact, only the slightest discharge.

B. H., æt. 17: glass-cut; section, in palm, of median branches of fore-finger; complete insensibility of this part; the last inch of the fore-finger is purplish, excessively wasted, shining, and smooth. At the seventh day, the hand having been carefully guarded, a bulla broke out on the fore-finger, and left the whole of the face of the member ulcerated. The nail fell off, and after the ulcer healed frequent bullæ occurred. The new nail is deformed.

In these cases the sections were complete. In two others, in which there were incomplete lesions of the palmar median nerves, the trophic disorders were joint lesions, herpetic

eruptions, minute ulcers, shining skin, and deformed nails, and loss of hair on last phalanx dorsal aspect (one case). In both, median nerve exsections, to relieve pain, were followed by continuance of the trophic changes, and by frequent bullæ in one case. Entire section is not therefore always competent to put an end to irritative lesions caused by imperfect sections.

In one other case of complete median section, I have seen necrosis of the last phalanx of the fore-finger without exposure to violence.

It must be admitted that in the vast majority of cases of complete sections no marked trophic changes occur, but that in a small per centage these do certainly follow. The interest of the matter lies in the fact that they never are seen in the face.

I may be permitted again to say that most of the cases quoted were under my immediate care, and that the trophic accidents were not due to traumatic causes. Moreover, in some of them the bullæ and ulcers continued to appear for months.

The second group of facts to which I desire to call attention is still more remarkable. I have so far observed it only in median sections, and altogether but twice. Since I first observed the phenomenon in question I have had but one occasion to cut the median. It may therefore be exceptional or common.

The facts of the first case were these:—

Traumatic injury of median nerves in palm, in girl of 17 years. Intense pain in peripheral median distribution on motion of hand; total insensibility to pain and touch in fore-finger median regions, partial in rest of median areas.

Section of median at third month, 3 inches above wrist—removal of one inch of nerve. At the eighth day after operation I examined the hand with care, and found the following conditions. Again and again since, the same study has been made; and soon after my first inspection, Dr. Morris Lewis made the careful diagrams, which explain far better than any description in words can do the character of the sensory changes.

Between the dotted line — . — . — . (Diagrams 1 and 2) and the continuous line ———, lies a space within which the

sense of touch to a light impact (feather) was lessened or indistinct. The region far more than covers the usual area of median distribution; and in fact, as I have already said, nothing can be more uncertain than this territory, which nevertheless the Anatomies describe as rigid. Clinical sections enable us to see that it may extend to the middle of the third finger (medius) in one case, to the whole medius in another; to the half also of the fourth finger (ring) in a third instance; while in yet another case, the median was found to innervate in part even the ulnar side of the fourth digit.

Whether this extensive defect be due, in the present case, to an unusual distribution of median fibres, or to a reflex disturbance of central perceptivity, owing to the influence of the section, I cannot say.

Within the continuous line the sense of pain should, according to our old ideas, be annihilated, as it incloses territory most of which is usually supposed to be fed by the median nerve. But let us see what a curious state of things does really exist.

The areas, which are darkened (stippled), and which on the dorsum (Figs. 1 and 2) are far more extensive than those commonly innervated by the median nerve, have neither sense of touch, pain, nor temperature. Heat and cold, needle-pricks, pinching, and deep pressure, are alike unfelt. The singular distribution of this analgesic area will be noticed. It is seemingly most eccentric, and does not correspond to any special distribution of separate branches of the median nerve.

There are also within the continuous line two areas, the one marked by lines running in the axis of the limb, the second by transverse lines. The former territory has no tact-sense; but if the skin be pinched with a small forceps, or indented by the pressure of a blunt point, or firmly by the finger, the result is most agonizing pain, so that the patient may cry out.

In the area transversely marked, the pinching is not felt; but firm deep pressure causes pain; and in both territories the site of the pain is fairly well localised. In both of these areas the altered skin-spaces are insensible to the prick of a very fine needle, if this be oiled and introduced laterally into



Fig. 1.

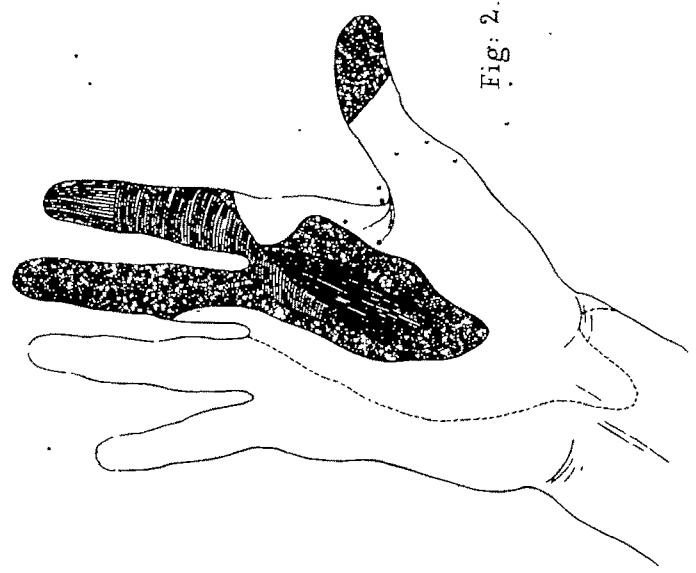


Fig. 2.

doubtful. It was but too plain that the median had partially remade its mischievous connections.

In May 1877 Dr. Brinton cut down on the median, and found large buttons as usual, but the filaments between were scarcely perceptible. Accordingly, I lifted the central portion above the upper button, wiped it dry, and put it on a piece of caoutchouc; then, I faradised it gently, when the median thumb muscles all moved freely. The nerve was then cut, and three inches removed.

After two weeks she was well enough to be examined with care, when I obtained the following singular facts, as shown in Diagrams Nos. 3 and 4.

Within the dotted line, and up to the continuous line, touch was impaired in various degrees, most on the middle finger. The area differs remarkably from that of the loss in Case 1.

In the areas of the diagram which are striated in the line of the limb there was very marked impairment of touch, and the most exquisite pain on pinching and on pressure, while the needle was painful only when carried in deeply below the skin.

The areas marked with transverse lines had no sense of tact, and did not feel pain when lightly—not deeply or largely—pinched, but were subject to intense pain on deep pressure with a blunt point.

The two cases here given are valuable, chiefly because they have been studied with unusual care. Most of such opportunities fall into the hands of surgeons, and the histories are anything but complete. Even of the later cases this is true; and I can scarcely recall a case in which the amount, character, and area of sensation-loss are stated fully and clearly. In my own examples we must remember that the median nerves in the palm had been subjected to prolonged irritation; then came section, and complete relief of active pain.

I shall first consider Case 1. We find what still exists unaltered, extensive loss of touch, with loss of the previously existent hyperalgesia of the surface; while in certain areas, different in each case, and most eccentric in their boundaries, we have two curious states:—

1st. Intense over-sensitiveness of subcuticular tissues, as shown by pain on pinching and pressure; and

Fig: 2.

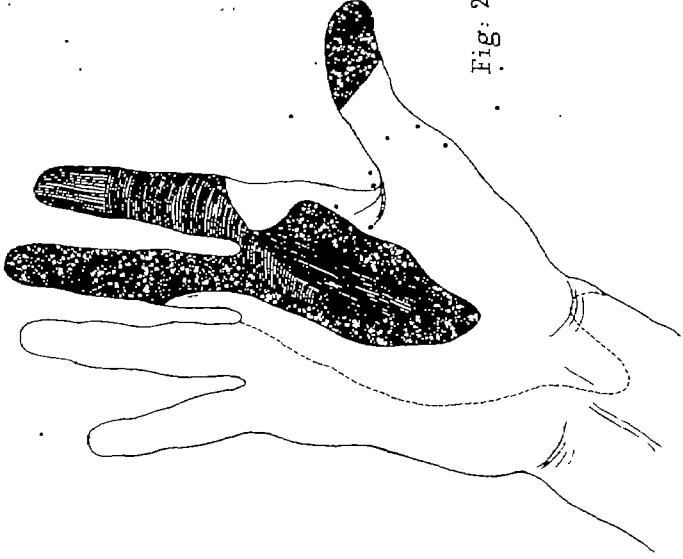
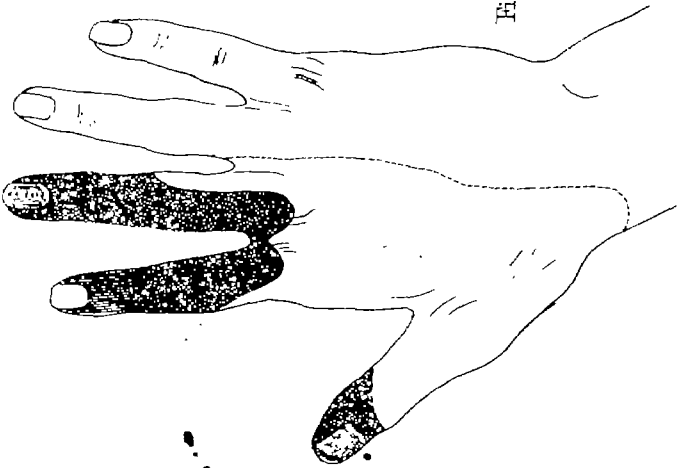


Fig: 1.



so as not to indent it roughly. If roughly or deeply in the skin, it causes pain. It should be added, that the patient was securely blindfolded during the process of testing.

The second case is yet more difficult to explain. Its history is, in brief, this:—

Miss T., at the age of $2\frac{1}{2}$ years, ran a splinter into the right palm, where the median branches. The wound healed over it. At the age of 22 years, Miss T. bruised the region in question; severe pain ensued in the thumb, fore and middle fingers. Dr. Sapolini, of Milan, removed the splinter, Oct. 1871. It was lying among the nerve filaments, and its removal was followed by exquisite torment, with causalgia and hyperalgesia.

In Sept. 1871, Dr. Sapolini, finding that pressure on the median trunk made the pain worse, and that pressure on the musculo-spiral nerve eased it, cut out one inch of the latter nerve—result, no pain for eight days; then return of all the symptoms. The extensor masses of the fore arm wasted rapidly, and wrist drop of course ensued.

Feb. 1874: section of median low down in the fore arm. Result, in fourteen days entire relief, and anæsthesia and analgesia of median regions of thumb, fore finger, and up to an irregular line on palmar face of median finger. Tact was disturbed over a wider area, including the lower part of the whole palmar face of the ring finger.

In March 1876 there was great pain in and below the line of section of the musculo-spiral, and in its dorsal distribution on the hand. The extensors were as large as usual, and acting well. After much fruitless medication, I had the musculo-spiral examined at the point cut. It was thoroughly remade. Two inches were removed, including two large terminal buttons, between which ran the new nerve. Results, paralysis of extensors, and relief to this date, June 1, 1878.

In January 1877 Miss T. came to me complaining of a return of all the old pains in the median areas. Sensation was partly restored, and I could move the median thumb muscles by galvanising the main trunk above the line of section, though whether she could also effect this by will was

doubtful. It was but too plain that the median had partially remade its mischievous connections.

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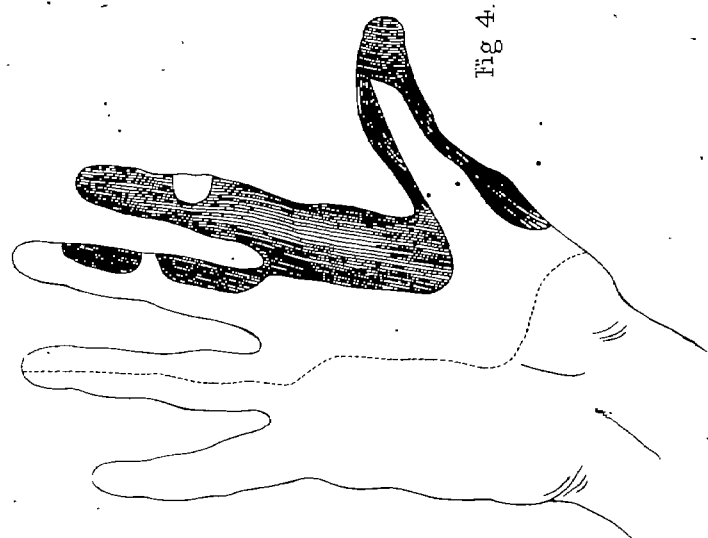


Fig 4.

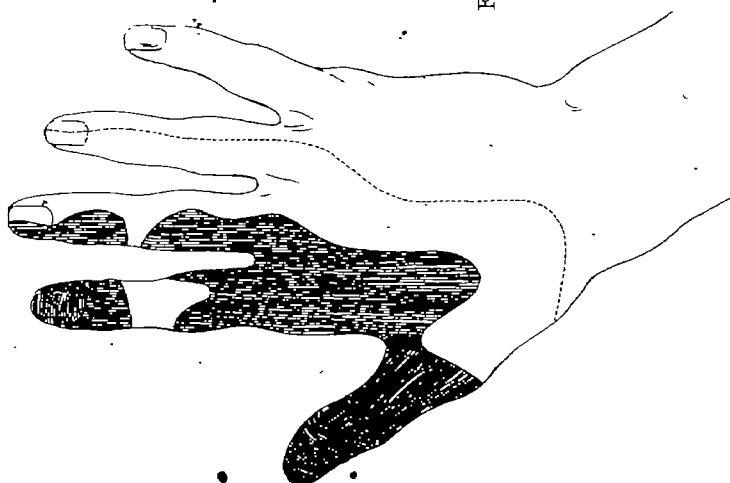


Fig 3.

2nd. More or less power to state the locality of the pain.

It is probable that my cases are not exceptions, and how shall we explain these facts? It is quite possible that like states existed before the operation; but this is hard to know, on account of the pain then given by an examination; but why should the operation, which annihilates touch, leave pain-power unaltered in the regions under the skin?

It is quite sure that there are frequent anomalies in nerve distribution, so that as a consequence the median gets more ulnar fibres than usual in the lower half of the palm; but this also is incapable of explaining the facts, since some of the new pain-areas are in the thumb, which has no such fibres in any case, while we find like pain areas also on the dorsal aspect of the fingers.

Moreover, why should such untouched connections not leave us areas of touch, even if lessened touch? and why should they only preserve or permit the parts to acquire an abnormal sub-surface sensitiveness to pain?

We have, of course, to believe that there remain connections of some kind with the centres: and we are obliged, I think, to fall back for explanation upon the recurrent nerve fibres, which Bernard, Arloing, and Trippier have shown to exist so widely.

The function of these nerves is as yet unknown, but the present cases show, I believe, that whatever be the normal activities of recurrent fibres, they may become the means both of feeling pain and of enabling us to localise it.

I am inclined to think, although I am not sure, that the changes which sensitize these fibres arise, at least in part, out of the previously existing irritations; but this is a question which can only be decided by future cases. If due to the section, the new sensitiveness may be a consequence of altered vascular states caused by the operation, since it is unlikely that the Wallerian degeneration of the neighbouring fibres could affect the recurrent fibres, which are left practically untouched, and have been sometimes seen to be unaltered in parts of nerves below the section. This alone seems sure, that the primary irritation or the section so influence the recurrent fibres, which reach the centre through the ulnar and radial connections of the median, as to give them new and

abnormal capacities to feel pain. At all events, these cases seem to open a novel chapter in neural pathology.

The second case is more complicated, because the musculo-spiral had been cut a year before the median. Yet not only was there the same phenomenon of pain areas, but a remarkable preservation of touch, far greater, in fact, than after the first median section. It is but too probable that already repair had begun in the musculo-spiral, since otherwise the preservation of sensitiveness to touch and pain rests inexplicable, even with the most liberal view of possible ulnar anomalies.

And now to return for a moment to Brown-Séquard's law. I have said that the present facts seem to contradict it. Certainly this is true of the simple nerve sections first related; but is it also true of the last and more remarkable cases?

We have here irritation long continued, intense peripheral pain and analgesia. We cut the main nerve, and pain areas still exist, inexplicable as due to coarse anastomoses. If we pre-suppose a descending neuritis, it would involve recurrent nerves as they enter the branches below the irritated point. Section of the nerve would of course fail to influence these recurrent fibres; but by raising the temperature, and though the local vaso-motor section induces palsy, it might well add fresh causes of irritation to those already affecting the recurrent fibres.

The latter of the cases I have adduced would not, therefore, contradict the law of Brown-Séquard.

In both of the cases last quoted, the areas in which pain was caused by deep pressure are insensitive to heat and cold as such, but both give rise, after a few moments' contact, to sense of dull pain. We may infer, therefore, that in these instances whatever fibres carried impression of pain and, in one case, of touch, were unable to perform the same office for thermal impressions.

In this condition I leave for the present this most puzzling problem in neuro-pathology. I trust that the chances offered to solve it through accidental sections, where there has been no previous irritation, will not be neglected.

The practical question which these phenomena leave to us is, whether it is not best at all risks to open the palm, and

remove the portions of irritated nerve-fibres, when section above them has failed to relieve pain. The two hands I have described are now useless, owing to the sensitiveness I have spoken of. There is no spontaneous pain, but the member cannot be used, since all pressure gives rise to intense distress.

Among the consequences of sections which I do not find mentioned, are the remarkable hyperalgesia in and near the line of wound; and, what I have seen thrice, troublesome and repeated herpes along the lips of the yet unclosed wound. Irritable and obstinate ulceration also attends the healing of these wounds in a small proportion of the cases.

Repeated section of the same nerve has been several times needful in my experience. It has been called for in these cases by return of the pains which were relieved by the first section.

If, however, I have correctly studied and reported the two cases last stated, we may come face to face with a hitherto unrecognised difficulty. Pain exists: we cut the main nerve; relief of spontaneous pain ensues, but after a brief time we have pain on pressure. If now at a remoter date this increases, and spontaneous pain be added, how shall we feel sure that the increase is due to a remade nerve? The test of increased surface-sensibility to touch is the earliest reliable functional evidence of such reconstruction, and precedes the return of muscular manifestations. It is, however, a less certain test than the diminution of atrophy in the muscular masses, and the capacity to move the muscles by currents, which include portions of the cut nerve above the line of section. This latter test is absolute, and enables us to feel sure that the nerve has been remade, and that a second operation has become justifiable. Whether it precedes or not the revival of will-power over the muscles, I have not been able as yet to determine with certainty; but I am inclined to think that it does anticipate in some cases the normal functional manifestations.

That the skin-sense returns before the muscles regain volitional or electrical activity depends, I presume, upon the fact that the nerve must be remade before the muscle can be reconstructed, and that until it is so reconstructed it cannot begin to respond to volitional or electrical stimulus.

ON AFFECTIONS OF SPEECH FROM DISEASE OF THE BRAIN.

BY J. HUGHLINGS-JACKSON, M.D., F.R.C.P., F.R.S.,

Physician to the London Hospital, and to the Hospital for the Epileptic and Paralysed.

It is very difficult for many reasons to write on Affections of Speech. So much, since the memorable researches of Dax and Broca, has been done in the investigation of these cases of disease of the brain, that there is an *embarras de richesses* in material. To refer only to what has been done in this country, we have the names of Gairdner, Moxon, Broadbent, William Ogle, Bastian, John W. Ogle, Thomas Watson, Alexander Robertson, Ireland, Wilks, Bristowe, Ferrier, Bateman, and others. To Wilks, Gairdner, Moxon, Broadbent, and Ferrier, I feel under great obligations. Besides recognising the value of Broadbent's work on this subject, I have to acknowledge a particular indebtedness to him. Broadbent's hypothesis—a verified hypothesis—is, I think, essential to the methodical investigation of affections of speech. Let me give at once an illustration of its value. It disposes of the difficulty there otherwise would be in holding (1) that loss of speech is, on the physical side, loss of nervous arrangements for highly special and complex articulatory *movements*, and (2) that in cases of loss of speech the articulatory *muscles* are not paralysed, or but slightly paralysed. I shall assume that the reader is well acquainted with Broadbent's researches on the representation of certain movements of the two sides of the body in each side of the brain; the reader must not assume that Broadbent endorses the applications I make of his hypothesis. The recent encyclopædic

article on Affections of Speech, by Kussmaul, in Ziemssen's 'Practice of Medicine,' is very complete and highly original. It is worthy of most careful study.

The subject has so many sides—psychological, anatomical, physiological, and pathological—that it is very difficult to fix on an order of exposition. It will not do to consider affections of speech on but one of these sides. To show how they mutually bear, we must see each distinctly. For example; we must not confound the physiology of a case with its pathology, by using for either the vague term "disease." Again, we must not ignore anatomy when speaking of the physical basis of words, being content with morphology, as in saying that words "reside" in this or that part of the brain. Supposing we could be certain that this or that grouping of cells and nerve-fibres was concerned in speech, from its being always destroyed when speech is lost, we should still have to find out the anatomy of the centre. Even supposing we were sure that the psychical states called words, and the nervous states in the "centre for words," were the same things, we should still have the anatomy of that centre to consider. The morphology of a centre deals with its shape, with its "geographical" position, with the sizes and shapes of its constituent elements. A knowledge of the anatomy of a centre is a knowledge of the parts of the body represented in it, and of the ways in which these parts are therein represented. Whilst so much has been learned as to the morphology of the cerebrum—cerebral topography—it is chiefly to the recent researches of Hitzig and Ferrier that we are indebted for our knowledge of the anatomy of many of the convolutions, that is, a knowledge of the parts of the body these convolutions represent. It is supposed that the anatomy of the parts of the brain concerned with words is that they are cerebral nervous arrangements representing the articulatory muscles in very special and complex movements. Similarly, a knowledge of the anatomy of the centres concerned during visual ideation is a knowledge of those regions of the brain where certain parts of the organism (retina and ocular muscles) are represented in particular and complex combinations. A merely materialistic or morphological explanation of speech or mind,

supposing one could be given, is not an anatomical explanation. Morphologically, the substratum of a word or of a syllable is made up of nerve-cells and fibres: anatomically speaking, we say it is made up of nerve-cells and fibres representing some particular articulatory movement.

Unless we most carefully distinguish betwixt psychology and the anatomy and physiology of the nervous system in this inquiry, we shall not see the fundamental similarity there is betwixt the defect often described in psychological phraseology as "loss of memory for words," and the defect called ataxy of articulation. A method which is founded on classifications which are partly anatomical and physiological, and partly psychological, confuses the real issues. These mixed classifications lead to the use of such expressions as that an *idea* of a word produces an articulatory movement; whereas a psychical state, an "idea of a word" (or simply "a word") cannot produce an articulatory movement, a physical state. On any view whatever as to the relation of mental states and nervous states such expressions are not warrantable in a *medical* inquiry. We could only say that discharge of the cells and fibres of the anatomical substratum of a word produces the articulatory movement. In all our studies of diseases of the nervous system we must be on our guard against the fallacy that what are physical states in lower centres fine away *into* psychical states in higher centres; that, for example, vibrations of sensory nerves *become* sensations, or that somehow or another an idea produces a movement.

Keeping them distinct, we must consider now one and now another of the several sides of our subject: sometimes, for example, we consider the psychical side—speech—and at other times the anatomical basis of speech. We cannot go right on with the psychology, nor with the anatomy, nor with the pathology of our subject. We must consider now one and now the other, endeavouring to trace a correspondence betwixt them.

I do not believe it to be possible for any one to write methodically on these cases of disease of the nervous system without considering them in relation to other kinds of nervous disease; nor to be desirable in a medical writer if it were pos-

sible. Broadbent's hypothesis is exemplified in cases of epilepsy and hemiplegia, as well as in cases of affections of speech, and can only be vividly realised when these several diseases have been carefully studied. Speech and Perception ("words" and "images") co-operate so intimately in Mentation (to use Metcalfe-Johnson's term) that the latter process must be considered. We must speak briefly of Imperception—loss of images—as well as of loss of Speech—loss of symbols. The same general principle is, I think, displayed in each. Both in delirium (partial imperception) and in affections of speech the patient is reduced to a more automatic condition; respectively reduced to the more organised relations of images and words. Again, we have temporary loss or defect of speech after certain epileptiform seizures: temporary affections of speech after these seizures are of great value in elucidating some difficult parts of our subject, and cannot be understood without a good knowledge of various other kinds of epileptic and epileptiform paroxysms, and post-paroxysmal states. After a convulsion beginning in the (right) side of the face or tongue, or in both these parts, there often remains temporary speechlessness, although the articulatory muscles move well. Surely we ought to consider cases of discharge of the centres for words as well as cases in which these centres are destroyed, just as we consider not only hemiplegia but hemispasm. Before trying to analyse that very difficult symptom called ataxy of articulation, we should try to understand the more easily studied disorder of co-ordination, locomotor ataxy; and before that, the least difficult disorder of co-ordination of movements resulting from ocular paralysis. Unless we do, we shall not successfully combat the notion that there are centres for co-ordination of words which are something over and above centres for special and complex movements of the articulatory muscles, and that a patient can, from lesion of such a centre, have a loss of co-ordination, without veritable loss of some of the movements represented in it.

It might seem that we could consider cases of aphasia, as a set of symptoms at least, without regard to the pathology of different cases of nervous disease. We really could not.

It so happens that different morbid processes have what, for brevity, we may metaphorically call different seats of election; thus, that defect of speech with which there are frequent mistakes in words is nearly always produced by local cerebral softening; that defect which is called ataxy of articulation, is, I think, most often produced by hæmorrhage. Hence we must consider hemiplegia in relation to affections of speech; for it so happens that the first kind of defect mostly occurs, as Hammond has pointed out, without hemiplegia, or without persistent hemiplegia, a state of things producible by embolism and thrombosis, and the latter mostly with hemiplegia and persistent hemiplegia, a state of things usually produced by hæmorrhage. From ignoring such considerations, the two kinds of defects are by some considered to be absolutely different, whereas on the anatomico-physiological side they are but very different degrees of one kind of defect.

There are certain most general principles which apply, not only to affections of speech, but also to the commonest variety of paralysis, to the simplest of convulsive seizures, and to cases of insanity.

The facts that the speechless patient is frequently reduced to the use only of the most general propositions "yes" or "no," or both; that he may be unable to say "no" when told, although he says it readily in reply to questions requiring dissent; that he may be able ordinarily to put out his tongue well, as for example to catch a stray crumb, and yet unable to put it out when he tries, after being asked to do so; that he loses intellectual language and not emotional language; that although he does not speak, he understands what we say to him; and many other facts of the same order, illustrate exactly the same principle as do such facts from other cases of disease of the nervous system as—that in hemiplegia the arm suffers more than the leg; that most convulsions beginning unilaterally begin in the index finger and thumb; that in cases of post-epileptic insanity there are degrees of temporary reduction from the least towards the most "organised actions," degrees proportional to the severity of the discharge in the paroxysm, or rather to the amount of exhaustion of the highest centres produced by the discharge causing the paroxysm. In all

these cases—except in the instance of convulsion, which, however, illustrates the principle in another way—there are, negatively, degrees of loss of the most voluntary processes with, positively, conservation of the next most voluntary or next more automatic; otherwise put, there are degrees of loss of the latest acquirements with conservation of the earlier, especially of the inherited, acquirements; speaking of the physical side, there are degrees of loss of function of the least organised nervous arrangements with conservation of function of the more organised. There is in each reduction to a more automatic condition: in each there is Dissolution, using this term as Spencer does, as the opposite of Evolution.¹

In *defects* of speech we may find that the patient utters instead of the word intended a word of the same class in meaning, as “worm-powder” for “cough-medicine”; or, in sound, as “parasol” for “castor oil.” The presumption is that the patient uses what is to him a more “organised” or “earlier” word, and if so, Dissolution is again seen. But often there is no obvious relation of any sort betwixt the word said and the one appropriate, and thus the mistake does not appear to come under Dissolution. If, however, we apply the broad principles which we can, I think, establish from other cases of Dissolution, viz. from degrees of insanity—especially the slight degrees of the post-epileptic insanity just spoken of—we shall be able to show that many of the apparently random mistakes in words are not real exceptions to the principle of Dissolution.

For the above reasons I shall make frequent references to other classes of nervous disease. The subject is already complex without these excursions, but we must face the complexity. Dr. Curnow has well said (*Medical Times and Gazette*, Nov. 29, p. 616), “The tendency to appear exact by disregarding the complexity of the factors is the old failing in our medical history.”

¹ Here I must acknowledge my great indebtedness to Spencer. The facts stated in the text seem to me to be illustrations from actual cases of disease, of conclusions he has arrived at deductively in his *Psychology*. It is not affirmed that we have the exact opposite of Evolution from the apparently brutal doings of disease; the proper opposite is seen in healthy senescence, as Spencer has shown. But from disease there is, in general, the corresponding opposite of Evolution.

Certain provisional divisions of our subject must be made. The reader is asked to bear in mind that these are admittedly arbitrary; they are not put forward as scientific distinctions. Divisions¹ and Arrangements are easy, Distinctions and Classifications are difficult. But in the study of a very complex matter, we must first divide, and then distinguish. This is not contradictory to what was said before on the necessity of encountering the full complexity of our subject. Harm comes, not from dividing and arranging, but from stopping in this stage, from taking provisional divisions to be real distinctions, and putting forward elaborate arrangements, with divisions and subdivisions, as being classifications. In other words, we shall, to start with, consider our subject empirically, and afterwards scientifically; we first arbitrarily divide and arrange for convenience of obtaining the main facts which particular cases supply, and then try to classify the facts, in order to show their true relations one to another, and consider them on the psychical side as defects of mind, and on the physical side as defects of the nervous system. Empirically we consider the cases of affection of speech we meet with, as they *approach* certain nosological types (most frequently occurring cases), scientifically we classify the facts thus obtained, to show how affections of speech are *departures from* what we know of healthy states of mind and body. The latter study is of the cases as they show different degrees of nervous Dissolution.

Let us first of all make a very rough popular division. When a person "Talks" there are three things going on—Speech, Articulation, and Voice. Disease can separate them. Thus from disease of the larynx, or from paralysis of its

¹ "How often would controversies be sweetened were people to remember that 'Distinctions and Divisions are very different things,' and that 'one of them is the most necessary and conducive to true knowledge that can be: the other, *when made too much of*, serves only to puzzle and confuse the understanding.' Locke's words are the germ of that wise aphorism of Coleridge: 'It is a dull or obtuse mind that must divide in order to distinguish; but it is a still worse that distinguishes in order to divide.' And if we cast our eyes back over time, it is the same spirit as that which led Anaxagoras to say, 'Things in this one connected world are not cut off from one another as if with a hatchet.'—*Westminster Review* (art. Locke), January 1877 (no italics in original).

nerves, we have loss of voice, but articulation and speech remain good. Again, in complete paralysis of the tongue, lips, and palate, articulation is lost, but speech is not even impaired; the patient remains able to express himself in writing, which shows that he retains speech—internal speech—that he propositionises well. Lastly, in extensive disease in a certain region in one half of the brain (left half usually) there is loss of speech, internal and external, but the articulatory muscles move well.

Let us make a wider division. Using the term Language, we make two divisions of it, Intellectual and Emotional. The patient, whom we call speechless (he is also defective in pantomime), has lost intellectual language and has not lost emotional language.

The kind of case we shall consider first is that of a man who has lost speech, and whose pantomime is impaired, but whose articulatory muscles move well, whose vocal organs are sound, and whose emotional manifestations are unaffected. This is the kind of case to be spoken of as No. 2 (p. 314).

The term Aphasia has been given to affections of speech by Trousseau; it is used for defects as well as for loss of speech. I think the expression Affections of Speech (including defects and loss) is preferable. Neither term is very good, for there is, at least in many cases, more than loss of *speech*; pantomime is impaired; there is often a loss or defect in symbolising relations of things in any way. Dr. Hamilton proposes the term Asemasia, which seems a good one. He derives it “from *ἀ* and *σημαίνω*, an inability to indicate by signs or language.” It is too late, I fear, to displace the word aphasia. Aphasia will be sometimes used as synonymous with Affections of Speech in this article.

We must at once say briefly what we mean by speech, in addition to what has been said by implication when excluding articulation, as this is popularly understood, and voice. To speak is not simply to utter words, it is to propositionise. A proposition is such a relation of words that it makes one new meaning; not by a mere addition of what we call the separate meanings of the several words; the terms in a proposition are

modified¹ by each other. Single words are meaningless, and so is any unrelated succession of words. The unit of speech is a proposition. A single word is, or is in effect, a proposition, if other words in relation are implied. The English tourist at a French *table d'hôte* was understood by the waiter to be asking for water when his neighbours thought he was crying "oh!" from distress. It is from the use of a word that we judge of its propositional value. The words "yes" and "no" are propositions, but only when used for assent and dissent; they are used by healthy people interjectionally as well as propositionally. A speechless patient may retain the word "no," and yet have only the interjectional or emotional, not the propositional, use of it; he utters it in various tones as signs of feeling only. He may have a propositional use of it, but yet a use of it short of that healthy people have, being able to reply "no," but not to say "no" when told; a speechless patient may have the full use of it. On the other hand, elaborate oaths, in spite of their propositional structure, are not propositions, for they have not, either in the mind of the utterer or in that of the person to whom they are uttered, any meaning at all; they may be called "dead propositions." The speechless patient may occasionally swear. Indeed he may have a recurring utterance, e.g. "Come on to me," which is propositional in structure but not, to him, propositional in use; he utters it on any occasion, or rather on no occasion, but every time he tries to speak.

Loss of speech is therefore the loss of power to propositionise. It is not only loss of power to propositionise aloud (to talk), but to propositionise either internally or externally, and it may exist when the patient remains able to utter some few words. We do not mean, by using the popular term power, that the speechless man has lost any "faculty" of speech or propositionising; he has lost those words which serve in speech, the nervous arrangements for them being destroyed. There is no "faculty" or "power" of speech apart from words revived or revivable in propositions, any more than there is a "faculty" of co-ordination of move-

¹ On this matter see an able article in the *Cornhill Magazine*, May 1886. See also Waitz, 'Anthropology' (Collingwood's Translation), p. 241 *et seq.*

ments apart from movements represented in particular ways. We must here say too that besides the use of words in speech there is a service of words which is not speech; hence we do not use the expression that the speechless man has lost words, but that he has lost those words which serve in speech. In brief, Speechlessness does not mean entire Wordlessness.

It is well to insist again that speech and words are psychical terms; words have of course anatomical substrata or bases as all other psychical states have. We must as carefully distinguish betwixt words and their physical bases, as we do betwixt colour and its physical basis; a psychical state is always accompanied by a physical state, but nevertheless the two things have distinct natures. Hence we must not say that the "memory of words" is a *function* of any part of the nervous system, for function is a physiological term (*vide infra*). Memory or any other psychical state arises *during* not *from*—if "from" implies continuity of a psychical state with a physical state—functioning of nervous arrangements, which functioning is a purely physical thing—a discharge of nervous elements representing some impressions and movements. Hence it is not to be inferred from the rough division we just made of the elements of "talking," and from what was said of their "separation" by disease, that there is anything in common even for reasonable contrast, much less for comparison, betwixt loss of speech (a psychical loss) and immobility of the articulatory muscles from, say disease of the medulla oblongata, as in "bulbar paralysis" (a physical loss). As before said, we must not classify on a mixed method of anatomy, physiology, and psychology, any more than we should classify plants on a mixed natural and empirical method, as exogens, kitchen-herbs, graminaceæ, and shrubs. The things comparable and contrastable in the rough division are (1) the two physical losses: (a) loss of function of certain nervous arrangements in the cerebrum, which are not speech (words used in speech), but the anatomical substrata of speech; and (b) loss of function of nervous arrangements in the medulla oblongata. (2) The comparison, on the psychical side, fails. There is no psychical loss in disease of the medulla

oblongata to compare with loss of words, as this part of the nervous system, at least as most suppose,¹ has no psychical side; there is nothing psychical to be lost when nervous arrangements in the medulla oblongata are destroyed.

The affections of speech met with are very different in degree and kind, for the simple reason that the exact position of disease in the brain and its gravity differ in different cases; different amounts of nervous arrangements in different positions are destroyed with different rapidity in different persons. There is, then, no single well-defined "entity"—loss of speech or aphasia—and thus, to state the matter for a particular practical purpose, such a question as, "Can an aphasic make a will?" cannot be answered any more than the question, "Will a piece of string reach across this room?" can be answered. The question should be, "Can this or that aphasic person make a will?" Indeed, we have to consider degrees of affection of Language, of which speech is but a part. Admitting the occurrence of numerous degrees of affection of Language, we must make arbitrary divisions for the first part of our inquiry, which is an empirical one.

Let us divide roughly into three degrees: (1) *Defect of Speech*.—The patient has a full vocabulary, but makes mistakes in words, as saying "orange" for "onion," "chair" for "table"; or he uses approximative or quasi-metaphorical expressions, as "Light the fire up there," for "Light the gas." "When the warm water comes the weather will go away," for "When the sun comes out the fog will go away." (2) *Loss of Speech*.—The patient is practically speechless and his pantomime is impaired. (3) *Loss of Language*.—Besides being speechless, he has altogether lost pantomime, and emotional language is deeply involved.

To start with, we take the simplest case, one of *loss of speech*, No. 2 ("complete aphasia"). Cases of defect of speech (1) are far too difficult to begin with, and so, too, are those cases (3) in which there is not only loss of speech,

¹ I, however, believe, as Lewes does, that in so far as we are physically alive, we are psychically alive; that some psychical state attends every condition of activity of every part of the organism. This is, at any rate, a convenient hypothesis in the study of diseases of the nervous system.

but also deep involvement of that least special part of language which we call emotional language. Moreover, we shall deal with a case of permanent speechlessness. I admit, that making but three degrees of affection of language, and taking for consideration one kind of frequently occurring case, is an entirely arbitrary proceeding, since there actually occur very numerous degrees of affection of language, many slighter than, and some severer than, that degree (No. 2) we here call one of loss of speech. But, as aforesaid, we must study subjects so complex as this empirically before we study them scientifically; and for the former kind of study we must have what are called "definitions" by type, and state exceptions. This is the plan adopted in every work on the practice of medicine with regard to all diseases. Let us give an example of the twofold study. Empirically or clinically, that is for the art of medicine, we should consider particular cases of epilepsy as each *approaches this or that nosological type* ("le petit mal, le grand mal," &c.). For the science of medicine we should, so far as is possible, consider cases of epilepsy as each is dependent on a "discharging lesion" of this or that part of the cortex cerebri, and thus as it is a *departure from healthy states* of this or that part of the organism. We cannot do the latter fully yet, but the anatomico-physiological researches of Hitzig and Ferrier have marvellously helped us in this way of studying epilepsies, as also have the clinical researches of Broadbent, Charcot, Duret, Carville, and others.¹

The following are brief and dogmatic statements about a condition which is a common one—the kind of one we call loss of speech, our second degree (No. 2) of Affection of

¹ See Moxon, On the Necessity for a Clinical Nomenclature of Disease, *Guy's Hospital Reports*, vol. xv. In this paper Moxon shows conclusively the necessity of keeping the clinical, or what is above called empirical—not using that term in its popular bad signification—and scientific studies of disease distinct. After reading this paper, my eyes were opened to the confusion which results from mixing the two kinds of study. It is particularly important to have both an empirical arrangement and a scientific classification of cases of Insanity. An example of the former is the much-criticised arrangement of Skae; the scientific classification of cases of insanity, like that of affections of speech, would be regarding them as instances of Dissolution; the Dissolution in insanity begins in the highest and most complex of all cerebral nervous arrangements, the Dissolution

Language. The statements are about two equally important things; (1) of what the patient has lost in Language—his negative condition, and (2) of what he retains of Language—his positive condition. Here, again, is an illustration of a general principle which is exemplified in many if not in all cases of nervous disease, and one of extreme importance when they are scientifically considered as instances of nervous Dissolution. We have already stated the duality of many symptomatic conditions in the remarks on p. 308. Without recognising the two elements in all cases of affections of speech, we shall not be able to classify affections of speech methodically. If we do not recognise the duplex (negative and positive) condition, we cannot possibly trace a relation betwixt Nos. 1, 2, and 3 (p. 314). There can be no basis for comparison betwixt the wrong utterances in No. 1 and the non-utterances in Nos. 2 and 3—betwixt a positive and a negative condition—betwixt speech, however bad, and no speech. There is a negative and a positive condition in each degree; the comparison is of the three degrees of the negative element and the three degrees of the positive element; the negative and positive elements vary inversely. The condition of the patient No. 1, who made such mistakes as saying “chair” for “table” was duplex; (a) negatively in not saying “table,” and (b) positively, in saying “chair” instead; there is in such a case *loss* of some speech, with *retention* of the rest of speech. Hence the term defect of speech applied to such a case is equivocal; it is often used as if the actual utterance was the *direct* result of the disease. The utterance is wrong in that the words of it do not fit the things intended to be indicated; but it is the best speech under the circumstances, and is owing to activity of healthy (except perhaps slightly unstable) nervous elements. The real, the primary, fault is in the nervous elements which do not act, which are destroyed, or are for the time *hors de combat*. If then we compare No 1 with No. 2, we

causing affections of speech in a lower series. The one kind of classification is for diagnosis (for direct “practical purposes”), the other is for increase of knowledge, and is worthless for immediate practical purposes. The fault of some classifications of insanity is that they are mixed, partly empirical and partly scientific.

compare the two negative conditions, the inability to say "table," &c. (the loss of some speech) in No. 1, with the loss of nearly all speech in No. 2, saying the latter is a greater degree of the former, and we compare the two positive conditions, the retention of inferior speech (the wrong utterances) in No. 1, with in No. 2 the retention of certain recurring utterances and with the retention of emotional language, saying the latter is a minor or lower degree of language than the former. Unless we take note of the duplex condition in imperception (delirium and ordinary insanity), we shall not be able to trace a correspondence betwixt it and other nervous diseases. There are necessarily the two opposite conditions in all degrees of mental affections, from the slightest "confusion of thought" to dementia, unless the dementia be total.

THE PATIENT'S NEGATIVE CONDITION.

(1) *He does not speak.*—He can, the rule is, utter some jargon, or some word, or some phrase. With rare exceptions, the utterance continues the same in the same patient: we call these Recurring Utterances. The exceptions to the statement that he is speechless are two. (a) The recurring utterance may be "yes," or "no," or both. These words are propositions when used for assent or dissent, and they are so used by some patients who are for the rest entirely speechless. (b) There are Occasional Utterances. Under excitement the patient may swear: this is not speech, and is not exceptional; the oath means nothing; the patient cannot repeat it, he cannot "say" what he has just "uttered." Sometimes, however, a patient, ordinarily speechless, may get out a phrase appropriate to some simple circumstance, such as "good-bye" when a friend is leaving. This is an exception, but yet only a partial exception; the utterance is not of high speech value;¹ he cannot

¹ What is meant by an utterance of high speech value and by inferior speech will later on be stated more fully than has been just now stated by implication. When we cease dealing with our subject empirically and treat it scientifically, we hope to show that these so-called exceptions come in place under the principle of Dissolution. We may now say that speech of high value, or superior speech, is new speech, not necessarily new words and possibly not new combinations of words; propositions symbolising relations of images new to the speaker, as in care-

"say" it again, cannot repeat it when entreated; it is inferior speech, little higher in value than swearing. However, sometimes a patient, ordinarily speechless, may get out an utterance of high speech value; this is very rare indeed.

(2) *He cannot write*; that is to say, he cannot express himself in writing. This is called Agraphia (William Ogle). It is, I think, only evidence of the loss of speech, and might have been mentioned in the last paragraph. Written words are symbols of symbols. Since he cannot write, we see that the patient is speechless, not only in the popular sense of being unable to talk, but altogether so; he cannot speak internally. There is no fundamental difference betwixt external and internal speech; each is propositionising. If I say "gold is yellow" to myself, or think it, the proposition is the same; the same symbols referring to the same images in the same relation as when I say it aloud. There is a difference, but it is one of degree; psychically "faint" and "vivid," physically "slight" and "strong" nervous discharges. The speechless patient does not write because he has no propositions to write. The speechless man may write in the sense of penmanship; in most cases he can copy writing, and can usually copy print into writing, and very frequently he can sign his name without copy. Moreover he may write in a fashion without copy, making, or we may say drawing, a meaningless succession of letters, very often significantly the simplest letters, pothooks. His handwriting may be a very bad scrawl, for he may have to write with his left hand. His inability to write, in the sense of expressing himself, is loss of speech; his ability to make ("to draw") letters, as in copying, &c., shows that his "image series" (the materials of his perception) is not damaged.

Theoretically there is no reason why he should not write music without copy, supposing of course that he could have done that when well; the marks (artificial images) used in noting music, have no relation to words any way used. On this matter I have no observations. Trousseau writes in his

fully describing something novel, by inferior speech is meant utterances like, "Very well," "I don't think so," ready fitted to very simple and common circumstances, the nervous arrangements for them being well organised.

Lecture on Aphasia (*Syd. Soc. Trans.* vol. i. p. 270), "Dr. Lasague knew a musician who was completely aphasic, and who could neither read nor write, and yet could note down a musical phrase sung in his presence."

(3) In most cases the speechless patient *cannot read at all*, obviously not aloud, but not to himself either, including what he has himself copied. We suppose our patient cannot read. This is not from lack of sight, nor is it from want of perception; his perception is not itself in fault, as we shall see shortly.

(4) His power of making signs is impaired (pantomimic propositionising). We must most carefully distinguish pantomime from gesticulation. Throwing up the arms to signify "higher up," pantomime, differs from throwing up the arms when surprised, gesticulation, as a proposition does from an oath.

So far we have, I think, only got two things, loss of speech (by simple direct evidence, and by the indirect evidence of non-writing and non-reading) and defect of pantomime. There are in some cases of loss of speech other inabilities; the most significant are that a patient cannot put out his tongue when he tries, or execute other movements he is told, when he can move the parts concerned in other ways quite well.

THE PATIENT'S POSITIVE CONDITION.

(1) He can understand what we say or read to him; he remembers tales read to him. This is important, for it proves that, although Speechless, the patient is not Wordless. The hypothesis is that words are in duplicate; and that the nervous arrangements for words used in speech lie chiefly in the left half of the brain; that the nervous arrangements for words used in understanding speech (and in other ways) lie in the right also. Hence our reason for having used such expressions as "words serving in speech;" for there is, we now see, another way in which they serve. When from disease in the left half of the brain speech is lost altogether, the patient understands all we say to him, at least on matters simple to him. Further it is supposed that another use of the words which re-

main is the chief part of that service of words which in health precedes speech; there being an unconscious or subconscious revival of words in relation before that second revival which is speech. Coining a word, we may say that the process of Verbalising is dual; the second "half" of it being speech. It is supposed also that there is an unconscious or subconscious revival of relations of images, before that revival of images in relation which is Perception.

(2) His articulatory organs move apparently well in eating, drinking, swallowing, and also in such utterances as remain always possible to him (recurring utterances), or in those which come out occasionally. Hence his speechlessness is not owing to disease of those centres in the medulla oblongata for immediately moving the articulatory muscles; for in other cases of nervous disease, when these centres are so damaged that the articulatory muscles are so much paralysed that *talking* is impossible, the patient remains able to *speak* (to propositionise) as well as ever; he has internal speech, and can write what he speaks.

The following dicta may be of use to beginners. Using the popular expression "talk," we may say that if a patient does not talk because his brain is diseased, he cannot write (express himself in writing), and can swallow well; if he cannot talk because his tongue, lips, and palate are immovable, he can write well and cannot swallow well.

(3) His vocal organs act apparently well; he may be able to sing.

(4) His emotional language is apparently unaffected. He smiles, laughs, frowns, and varies his voice properly. His recurring utterance comes out now in one tone and now in another, according as he is vexed, glad, &c.; strictly we should say he sings his recurring utterance; variations of voice being rudimentary song (*Spencer*); he may be able to sing in the ordinary meaning of that term. As stated already, he may swear when excited, or get out more innocent interjections, simple or compound (acquired parts of emotional language). Although he may be unable to make any but the simplest signs, he gesticulates apparently as well as ever, and probably he does so more frequently and more copiously than he

used to do. His gesticulation draws attention to his needing something, and his friends guess what it is. His friends often erroneously report their guessing what he wants when his emotional manifestations show that he is needing something, as his expressing what thing it is that he wants.

So far for the negative and positive conditions of Language in our type case of Loss of Speech—No. 2 in Defect of Language.

Words are in themselves meaningless, they are only symbols of things or of "images" of things; they may be said to have meaning "behind them." A proposition symbolises a particular relation of some images.¹

We must then briefly consider the patient's condition in regard to the images symbolised by words. For although we artificially separate speech and perception, words and images co-operate intimately in most mentation. Moreover, there is a morbid condition in the image series (Imperception), which corresponds to aphasia in the word series. The two should be studied in relation.

The speechless patient's perception (or "recognition," or "thinking" of things) (propositions of images) is unaffected, at any rate as regards simple matters. To give examples: he will point to any object he knew before his illness which we name; he recognises drawings of all objects which he knew before his illness. He continues able to play at cards or dominoes; he recognises handwriting, although he cannot read the words written; he knows poetry from prose, by the different endings of the lines on the right side of the page. One of my patients found out the continuation of a series of papers in a magazine volume, and had the right page ready for her husband when he returned from his work; yet she, since her ill-

¹ The term "image" is used in a psychical sense, as the term "word" is. It does not mean "visual" images only, but covers all mental states which represent things. Thus we speak of auditory images. I believe this is the way in which Taine uses the term image. What is here called "an image" is sometimes spoken of as "a perception." In this article the term perception is used for a *process*, for a "proposition of images," as speech is used for propositions, i.e. particular inter-relations of words. The expression "organised image" is used briefly for "image, the nervous arrangements for which are organised," correspondingly for "organised word," &c.

ness, could not read a word herself, nor point to a letter, nor could she point to a figure on the clock. There is better and simpler evidence than that just adduced that the image series is unaffected; the foregoing is intended to show that the inability to read is not due to loss of perception nor to non-recognition of letters, &c., as particular marks or drawings, but to loss of speech. Written or printed words cease to be symbols of words used in speech for the simple reason that those words no longer exist to be symbolised; the written or printed words are left as symbols of nothing, as mere odd drawings. The simplest example showing the image series to be undamaged is that the patient finds his way about; this requires preconception, that is "propositions of images" of streets, &c. Moreover, the patient can, if he retains the propositional use of "yes" and "no," or if he has the equivalent pantomimic symbols, intelligently assent or dissent to simple statements, as that "Racehorses are the swiftest horses," showing that he retains organised nervous arrangements for the images of the things "swiftness" and "horse"; this has already been implied when it was asserted that he understands what we say to him, a process requiring not some of his words only, but also some of his "images" of things, of which the words are but symbols.

Such facts as the above are sometimes adduced as showing that the patient's "memory" is unaffected. That expression is misleading, if it implies that there is a general faculty of memory. There is no faculty of memory apart from things being remembered; apart from having, that is, now and again, these or those words, or images, or actions (faintly or vividly). We may say he has not lost the memory of images, or, better, that he has the images actually or potentially; the nervous arrangements being intact and capable of excitation did stimuli come to them; we may say that he has lost the memory of those words which serve in speech. It is better, however, to use the simple expression that he has not lost images, and that he has lost the words used in speech.

These facts as to retention of images are important as regards the writing of speechless patients. The printed or written letters and words are images, but they differ from

the images of objects, in being artificial and arbitrary, in being acquired later; they are acquired after speech and have their meaning only through speech; written words are symbols of symbols of images. The aphasic patient cannot express himself in writing because he cannot speak; but the nervous arrangements for those arbitrary images which are named letters are intact, and thus he can reproduce them as mere drawings, as he can other images, although with more difficulty, they, besides lacking their accustomed stimulus, being less organised. He can copy writing, and he can copy print into writing. When he copies print into writing, obviously he derives the images of letters from his own mind (physically his own organisation). He does not write in the sense of expressing himself, because there are no words reproduced in speech to express. That series of artificial images which makes up the signature of one's name has become almost as fully organised as many ordinary images; hence in many cases the speechless man who can write nothing else without copy can sign his name.

For the perception (or recognition or thinking) of things, at least in simple relations, speech is not necessary, for such thought remains to the speechless man. Words are required for thinking, for most of our thinking at least, but the speechless man is not wordless; there is an automatic and unconscious¹ or subconscious service of words.

It is not of course said that speech is not required for thinking on novel and complex subjects, for ordering images in new and complex relations (i.e. to the person concerned),

¹ The expression "unconscious reproduction of words," involves the same contradiction as does the expression, "unconscious sensation." Such expressions may be taken to mean that energising of lower, more organised, nervous arrangements, although unattended by any sort of conscious state, is essential for, and leads to, particular energisings of the highest and least organised—the now-organising—nervous arrangements, which last-mentioned energising is attended by consciousness. I, however, think (as Lewes does) that some consciousness or "sensibility" attends energising of all nervous arrangements (I use the term subconscious for slight consciousness). In cases where from disease the highest nervous arrangements are suddenly placed *hors de combat*, as in sudden delirium, the next lower spring into greater activity; and then, what in health was a subordinate subconsciousness, becomes a vivid consciousness, and is also the highest consciousness there then can be.

and thus the process of perception in the speechless, but not wordless, man may be defective in the sense of being inferior from lack of co-operation of speech: it is not itself in fault, it is left unaided.

To understand anything novel and complex said to him, the healthy man speaks it to himself, *e. g.* repeats, often aloud, complex directions of route given to him.

The word "thing" has not been used as merely synonymous with "substance"; nor is it meant that anybody has nervous arrangements for the images of "swiftness" and "horse," but only for images of some swiftly-moving thing or things, and for images of some particular horse or horses.

It may be well here to give a brief recapitulation of some parts of our subject and, also very briefly, an anticipation of what is to come; the latter is given partly as an excuse for having dwelt in the foregoing on some points not commonly considered in such an inquiry as this, and partly to render clearer some matters which were only incidentally referred to.

The division into internal and external speech (see p. 318) is not that just made into the dual service of words. Internal and external speech differ in degree only: such a difference is insignificant in comparison with that betwixt the prior unconscious, or subconscious, and automatic reproduction of words and the sequent conscious and voluntary reproduction of words; the latter alone is speech, either internal or external. Whether I can show that there is this kind of duality or not, it remains certain that our patient retains a service of words, and yet ordinarily uses none in speech. The retention of that service of words which is not a speech use of words, is sometimes spoken of as a retention of "memory of" words, or of "ideas of" words. But as there is no memory or idea of words apart from having words, actually or potentially, it is better to say that the patient retains words serving in other ways than in speech; we should say of his speechlessness, not that he has lost the memory of words, but simply that he has lost those words which serve in speech.

When we consider more fully the duality of the Verbalising process, of which the second "half" is speech, we shall try to show that there is a duality also in the revival of the

images symbolised; that perception is the termination of a stage beginning by the unconscious or subconscious revival of images which are in effect "image symbols"; that we think not only by aid of those symbols, ordinarily so-called (words), but by aid of symbol-images. It is, I think, because speech and perception are preceded by an unconscious or subconscious reproduction of words and images, that we seem to have "faculties" of speech and of perception, as it were, above and independent of the rest of ourselves. We seem to have a memory or ideas¹ of words *and* words; having really the two kinds of service of words. The evidence of disease shows, it is supposed, that the highest mentation arises out of our whole organised states, out of ourselves—that Will, Memory, &c., "come from below," and do not stand autocratically "above," governing the mind; they are simply the now highest, or latest, state of our whole selves. In simple cases of delirium (partial imperception with inferior perception) as when a patient takes his nurse to be his wife, we find, I think, a going down to and a revelation of what would have been when he was sane, the lower and earlier step towards his true recognition or perception of the nurse.

The first step towards his recognition of her when he was sane, would be the unconscious, or subconscious, and automatic reproduction of his, or of one of his, well-organised symbol-images of woman; the one most or much organised in him would be his wife. To say what a thing is is to say what it is like; he would not have known the nurse even as a woman, unless he had already an organised image of at least one woman. The popular notion is, that by a sort of faculty of perception, he would recognise her without a prior stage in which, he being passive, an organised image was roused in him by the mere presence of the nurse; the popular notion almost seems to imply the contradiction that he first sees her, in the sense of recognising her, and then sees her as like his already acquired or organised image

¹ The so-called *idea* of a word, in contradistinction to *the* word, is itself a word subconsciously revived, or revivable, before *the* conscious revival or revivability of the same word, which latter, in contradistinction to the so-called *idea* of a word, is the so-called *word itself*—*the* word.

of some woman. We seem to ourselves to Perceive, as also to Will and to Remember, without prior stages, because these prior stages are unconscious or subconscious. It seems to me that in delirium the patient is reduced to conditions which are revelations of, or of parts of, the lower earlier and prior stages; the lower or earlier stages are then conscious. They are, the *then* highest or latest conscious states. When the patient becomes delirious, he takes the nurse to be his wife. More or fewer of the highest nervous arrangements being then exhausted, the final stage is not possible; there is only the first stage; the reproduction of his well organised symbol-image is all there is, and that is all the nurse can be to him; she is, to him, his wife. The symbol-image is then vividly reproduced because the centres next lower than those exhausted are in abnormally great activity (note, that there are two conditions, one negative and the other positive). There is a deepening of consciousness in the sense of going down to lower earlier and more organised states, which in health are mostly unconscious or subconscious, and precede higher conscious states; in other words with loss or defect of object consciousness, even in sleep with dreaming, there is increasing subject consciousness; on the physical side, increasing energising of those lower centres which are in the day time more slightly energising during that unbroken subconscious "dreaming," from which the serial states, constituting our latest or highest object consciousness, are the continual "awakenings."

It is supposed that the well organised images spoken of—in effect arbitrary images, symbol-images, those which *become* vivid and are "uppermost" in delirium, and then cease to be mere symbols—constitute what seems to be a "general notion" or "abstract idea" of such things as "horse," "swiftness," &c.; their particularity (that they are only images of some horse or horses, of some swift moving thing or things) not appearing, because they are unconscious or subconscious; they served once as images of particular things, and at length as symbol-images of a class of images of things, as well as images of the particular things.

At page 319 we spoke of the right half of the brain as

being the part during the activity of which the most nearly unconscious and most automatic service of words begins, and of the left as the half during activity of which there is that sequent verbal action which is Speech. The division is too abrupt; some speech—voluntary use of words—is, as we have seen, when alluding to Occasional Utterances, possible to the man who is rendered practically speechless by disease in the left half. Again, from disease of the right half, there is not loss of that most automatic service of words which enables us to understand speech. The thing which it is important to show is, that mentation is dual, and that physically the unit of function of the nervous system is double the unit of composition; not that one half of the brain is “automatic” and the other “voluntary.”

Having now spoken of the kind of case we shall consider, and having added remarks, with the endeavour to show how the several symptoms—negative and positive—are related one to another, we shall be able to give reasons for excluding other kinds of cases of speechlessness.

We are not concerned with cases of all persons who do not speak. We shall not, for example, deal with those untrained deaf-mutes who never had speech, but with the cases of those persons only who have had it, and lost it by disease. The condition of an untrained deaf-mute is in very little comparable with that of our arbitrarily-taken case of loss of speech. The deaf-mute's brain is not diseased, but, because he is deaf, it is uneducated (or in anatomical and physiological phraseology undeveloped) so as to serve in speech. Our speechless patient is not deaf. Part of our speechless patient's brain is destroyed; he has *lost* nervous arrangements which had been trained in speech. Moreover, our speechless man retains a service of words which is not speech; untrained deaf-mutes have no words at all. Further, the untrained deaf-mute has his natural system of signs, which to him is of speech value so far as it goes. He will think by aid of these symbols as we do by aid of words.¹ Our speechless patient is defective even in such slight

¹ We must not confound the finger-talk with the “natural” system of signs. They are essentially different. No one supposes that words are essential for

pantomime as we may reasonably suppose to have been easy to him before his illness. The deaf-mute may have acquired for talking and thinking the common arbitrary system of deaf-mute signs (finger-talk), or he may have been taught by the new method to speak as we do, and thus have ceased to be mute. But when not taught to speak, he is not in a condition even roughly comparable with that of a man who has *lost* speech. No doubt by disease of some part of his brain the deaf-mute might lose his natural system of signs, which are of some speech value to him, but he could not lose speech, having never had it. Much more like our speechless patient's condition is that of the little child which has been taught to understand speech, and has not yet spoken.

There is another set of cases of so-called loss of speech, which we shall not consider as real loss of speech. I prefer to say that these patients *do* not speak: cases of some persons are meant, who do not talk and yet write perfectly. This may seem to be an arbitrary exclusion. There is in most of these cases an association of symptoms, which never arises from any local disease of any part of the nervous system; the so-called association is a mere jumble of symptoms. Let us state the facts. The patients are nearly always boys or unmarried women. The bearing of this is obvious. The so-called loss of speech is a total non-utterance, whereas it is an excessively rare thing for a patient who does not speak, because his brain is locally diseased, to have no utterance whatever; I do not remember seeing one such case in which there was not some utterance (recurring utterance) a few days or a few weeks after the onset of the illness; the absolute pseudo-speechlessness may remain for months. They cannot be mute from paralysis of the articulatory muscle, because they swallow well. Frequently there is loss of voice also—they get out no sounds except, perhaps, grunts, &c.—and yet they cough ringingly and breathe without hoarseness or stridor; there is no evidence of laryngeal disease. Now loss of voice never occurs with loss of speech from local disease of one side of the

thought, but only that some symbols are essential for conceptual thought, although it may be that people with "natural" symbols do not reach that higher degree of abstract thinking which people do who have words.

brain. No disease of the larynx would cause loss of speech or loss of articulation. The patients often "lose" their speech after calamity or worry. In these cases there is no hemiplegia and no other one-sided condition from first to last. They often, after months of not-speaking, recover absolutely and immediately after some treatment which can have no therapeutical effect, *e.g.* a liniment rubbed on the back, a single faradaic stimulation of the vocal cords or of the neck. Dr. Wilks has reported a case of "cure" of a girl who had not spoken for months; she had also "lost" the use of her legs. Knowing well what was the general nature of the case, Dr. Wilks, by speaking kindly to her, and giving her an excuse for recovery in the application of faradisation, got her well in a fortnight. Sometimes the so-called speechless patient speaks inadvertently when suddenly asked a question, and then goes on talking; is well again. Sometimes speech is surprised out of her. Thus a woman, whose case is recorded by Durham, when told to cry "ah!" when the spatula was holding down her tongue, pushed his hand away, saying, "How can I, with that thing in my mouth?" She then said, "Oh! I have spoken." She was "cured." I believe that patients, "speechless" as described, might be "cured" by faradisation of the vocal cords, or by a thunderstorm, or by quack medicines or appliances, or by mesmerism, or by wearing a charm, or—not speaking flippantly—by being "prayed over."

Sometimes these cases are spoken of as cases of "emotional aphasia"—the speechlessness is said to be "caused by" emotional excitement, because it often comes on *after* emotional disturbance.

I submit that the facts that the patients do not talk and *do* write and *do* swallow are enough to show that there is no disease at all, in any sense except that the patients are hysterical (which is saying nothing explanatory), or that they are pretending. There can be no *local* disease, at any rate.

These cases are spoken of at length, although they are excluded, because they are sometimes adduced as instances of aphasia, or loss of speech proper, with ability to write remaining. I confess that were I brought face to face with a man whom I believed to *have* local disease of his brain, who did not

METALLOSCOPY AND METALLOTHERAPY.

BY A. HUGHES BENNETT, M.D.,

*Physician to the Hospital for Epilepsy and Paralysis, Regent's Park, and
Assistant-Physician to the Westminster Hospital.*

THE treatment of disease by the external application of metals has been practised from the earliest ages. The ancients wore rings and amulets which, combined with supplications and sacrifices to the gods, performed marvellous cures. Paracelsus is reported to have placed metallic substances on the skin to relieve internal complaints, and Pomme, two centuries later, became celebrated for his treatment of nervous disorders by means of copper baths. The discovery during the eighteenth century of galvanism and electricity gave a fresh stimulus to researches on this subject, and the enthusiasm created by the knowledge of these powerful agents added a fresh impulse to the study of metallothrapy; galvanic and electric piles, batteries, and the application of simple metals were energetically employed as curative agents. Perkins, at the commencement of this century, used needles of different metals, which he thrust into the body, with the view of establishing electric currents. Twenty years later, when electricity began to be applied scientifically to medicine, various methods of external treatment by metallic substances were employed. Among others Raspail used plates of zinc and copper, Goldberger introduced galvanic chains, Sage applied powders of copper and steel, Recamier suggested poultices of copper and zinc, Pulvermacher constructed chains of zinc and copper, and there arose a host of other contrivances for the purpose of influencing abnormal states by means of external metallic applications.

M. Burq, in 1848, was the first to make a scientific investigation into, and to form any definite system on, the external application of metals to the treatment of disease, and in a remarkable work, he describes his extensive observations and experiments on the subject.¹ He ascertained that workers in copper were exempt from cholera during many of the severest epidemics of Paris, and he subsequently found that the external and internal administration of that metal relieved the symptoms of others when attacked with the disease in question.² He then maintained that chlorosis was cured by the external application of various metallic substances, which he accounts for by considering that affection not a disorder by itself, but only the symptom of a nervous disease over which this procedure has a beneficial influence.³

He subsequently applied his system to a variety of other affections, but met with the greatest success in the treatment of hysteria, the most troublesome symptoms of which were often relieved or cured.

Burq's method of procedure was first by means of small discs to ascertain the metal which had some influence on the patient, and then to envelop him in a sort of armour of the same substance. This cuirass was kept on for days, weeks, or months, until the beneficial changes were considered complete. The works of M. Burq during the last thirty years contain so many and remarkable cures by what seems so simple a process, that it is singular that the profession at large have apparently so little benefited by his instructions. Burqism, however, like Braidism, seems to be a doctrine which is more efficacious in the hands of its author than in those of others, and the results, if genuine, may possibly be due to the personal influence of an individual rather than to the exactness of a system. Hence both have hitherto been abandoned by the medical profession in the practical treatment of disease. They are closely related, Burq himself expressing great sympathy with mesmerism, and he admits that by means of metals he can

¹ 'Métallothérapie,' par Dr. V. Burq. Paris, 1853.

² 'Du Cuivre contre le Choléra,' par Dr. V. Burq. Paris, 1867.

³ 'L'Etude de la traitement de la Chlorose,' par Dr. V. Burq. Paris, 1852.

prognose those likely to be sensitive subjects in the operations of the Hypnotiser.

Professor Charcot, of Paris, has recently revived the system of Burq in the treatment of "Grave Hysteria," and in a recent number of the *Lancet* his views are expounded.¹ His observations have since been apparently confirmed by Dr. Henry Thompson,² Mr. Horrocks,³ in the wards of Dr. Wilks⁴ and others, both at home and abroad.

I have repeated all the experiments and observations of these authorities in several cases of anæsthesia and analgesia which have recently been under my care, and although brevity compels me to omit details, I venture to say a few words on the results obtained, and will use the writings of the above authors as a text for my remarks.

1. It is stated that in certain cases of anæsthesia and analgesia the application of various metals is followed by a return of sensibility to touch and pain. This I have ascertained to be a fact. In a case at present under observation, where there is complete hemianæsthesia, including the special senses of the right side, a limb treated after the process of Burq and Charcot is often entirely restored to its natural function. This restoration is usually temporary, but is sometimes permanent. Occasionally the effect extends over the whole body, but is more often confined to the limb or neighbourhood of the applied metal.

It is also asserted that each individual is influenced by one particular metal, while others fail to have a beneficial action. As far as my experience has gone it is not in accord with this statement: I have found, after repeated and extended trials, that it apparently makes little difference what substance is employed, the result being in all cases the same. For example, in one patient I tested a variety of metals without the slightest effect. Finally, on employing zinc, local sensibility was completely restored for some hours. Next day zinc was again used with similar results, and so on. Subsequently, on applying the metals which had formerly failed, the same phenomena ensued,

¹ *Lancet*, January 19th, 1878.

² *British Medical Journal*, November 30th, 1877.

³ *Guy's Hospital Gazette*, April 1878.

⁴ *British Medical Journal*, July 19th, 1878.

and sometimes when zinc was tested no change whatever took place. In short, in this case the application of metals usually induced changes in sensation, but there was no constancy as to the effects produced by any particular one of them; that which caused a return of sensibility yesterday did not to-day, and that which failed to-day might succeed to-morrow.

Finally, this question arose. Are the phenomena induced really due to any special virtue in the metal, as is alleged? To solve this problem I have applied discs of wood, and have produced thereby all the phenomena described as following the application of the metals. In a case at present in the Westminster Hospital, of a woman with complete hemianæsthesia and hemianalgesia from which she had suffered for upwards of a year, after testing a number of metals with varying success, I applied two wooden buttons to her arm. From complete insensibility to pain and touch in half an hour the arm was normal to both, and has remained so ever since, that is for the last three months, the other parts of the body continuing anæsthetic and analgesic as before. This observation with the wooden discs has been frequently repeated, and the results have been, in the writer's experience, as certain and constant as from any single metal.

2. It is stated that the muscular force, as measured by the dynamometer, is increased by the application of metals in anæsthetic cases. I have also found this statement in a certain degree to be correct. There can be no doubt that the arm and hand when sensitive to touch can exert a greater force than when they are anæsthetic. But whether due to any special metallic virtues is more than questionable, as the same results followed the treatment by wooden discs. In short, so far as my observations extend, I have found that a relation exists rather between the power and the sensation, from whatever cause modified, than between the power and the metal employed.

3. It is asserted that external metallic applications exert an influence on the circulation from the fact that when anæsthetic skin is pricked no blood flows from the punctures; but that after metals have been applied and the sensibility restored, this takes place. To a certain extent these observations are correct,

and I have repeatedly confirmed them. I have seen frequently that a puncture of anæsthetic skin by a needle did not bleed, while fresh pricks after the skin became sensitive were followed by bleeding points. But I have never seen the *same* punctures which did not bleed at first afterwards do so when the metal was applied. That these changes are due to the action of the metals *per se* on the circulation is also doubtful, as the same phenomena followed the application of the wooden discs.

The following observation, made by myself, may have some bearing on this subject. In a normal condition of the skin, if a needle be deliberately thrust through its thickness, taking care to avoid a vein, on withdrawal of the instrument no blood follows, as a rule. If, however, the skin be lightly pricked, small spots of blood issue from each puncture. If the same operations be made on anæsthetic skin, precisely similar phenomena ensue. In short, the nature of the wound inflicted by the needle seems alone to determine if blood shall follow, and this whether the skin be anæsthetic or not. This may serve to explain the circulatory changes supposed to be produced by the metals. When skin is anæsthetic the operator is not particular, he thrusts the needle deeply, and no blood in consequence appears. When sensibility is restored he is obliged to be more careful, and gently touches with the point of his instrument the sensitive integument, and, as nearly always occurs, blood is seen at several points. After the use of the metals I have frequently observed redness of the skin, but have always considered that this was due to the previous pricking and pinching necessary to test its anæsthetic condition. It must, however, be admitted that it is highly probable that the return of sensibility to a part indicates a change in its capillary circulation, and that sensitive portions of the skin are more likely to be vascular than those which are anæsthetic.

4. The phenomenon called by Burq "*l'anesthésie de retour*," I have occasionally seen as described by Charcot, but by no means constantly. He says that when the metal has been applied to anæsthetic skin, and sensibility restored, and if the treatment be continued, at a given moment the anæ-

thesia returns more persistently than before. I have never observed this sudden change. In my experience, the sensibility having been restored, either by metals or discs of wood, it remains an hour or more, and then gradually is lost. In some cases the application having been maintained for twenty-four hours, the anæsthesia was as great as before; in others, however, the sensibility was markedly increased. Charcot then says, if the metals are removed at the moment sensibility is restored, the effects are often permanent, and spread over the remainder of the body. This I have found to take place; but on the other hand, the same circumstances existing, the anæsthesia has often returned in a very short time, and when it remained has been limited to the spot or limb originally restored. In the case before cited, at present under observation, the right arm from absolute anæsthesia was restored to normal sensibility after the application of two discs of wood for an hour. The arm has remained in the same condition for three months, the rest of the body continuing anæsthetic.

5. The "*phénomène du transfert*" discovered by Charcot, he describes as follows:—Having applied a metal to an anæsthetic arm, and restored sensibility to a portion of it, the exactly corresponding part of the other, and hitherto normal, limb is found to be anæsthetic, and as this latter returns to its normal condition the former resumes its previous state. I myself have never observed such an exact displacement of sensibility. It has been noticed that occasionally, when the skin on one side has been restored to feeling of touch and pain, the corresponding portion of the other side has become less sensitive than before; but frequently no such phenomenon has taken place, one limb being changed, the other remaining in its usual condition.

6. The achromatopsy observed by Charcot, in which the patient loses the notion of colours in a certain mathematical regularity, and after the application of metals regains the knowledge of them in the same order, I have had no opportunity of definitely testing. In one case of hemianæsthesia on admission the patient could not, with her right eye, distinguish any colours; all seemed alike grey, some appearing

darker than others. A few days afterwards she said that blue was green, green was blue, light blue was grey, but failed even to attempt to name any others. A week subsequently she told all the colours correctly, and has done so ever since. This patient, up to that time, had received no treatment whatever.

7. Metalloscopy being the search for the metal which affects the patient, metallothrapy consists in employing the same for the treatment of disease, either by administering a solution of it internally, or by applying plates of it externally. From the foregoing remarks it is obvious that I can have had little opportunity of testing this, as I have never yet found a patient who was affected by one particular metal, and by it alone. In a case in which discs of zinc removed the anæsthesia, valerianate of zinc was taken for a month without any apparent effect; and in another case of anæsthesia of the leg, which was modified by the application of two pieces of wood, I, in joke, gave her frequent dram doses of infusion of quassia, and the patient declared herself well in a week. In a third case, where a small disc of zinc restored sensibility, a large plate of the same failed to do so the following day. Many remarkable cases, however, described by Burq, Charcot, Thompson, and others, may deserve consideration from the reputation of the observers.

In reviewing the whole question, one point may be admitted, namely, the genuine nature of these remarkable phenomena; and I can personally guarantee that in my own observations every possible precaution was taken to detect malingerer or unconscious deception, and to test the real accuracy of the results. The patients were all carefully blindfolded during the entire period of the experiment; not a word was spoken concerning the nature of the observation; no suggestive ideas were given, and no leading questions asked.

The practical problem to be solved appears to me to be this: Are the beneficial changes due to some special effect, electrical or otherwise, derived from a particular metal, or do they result from the influence its application exercises on the mind, which in its turn directly affects the body? • Precisely the same question was asked some years ago when "electro-biology"

startled the public mind by its marvellous revelations, and was conclusively answered by Braid and others. From the earliest ages, cures and miracles have been performed by very much similar processes, many of which were doubtless genuine, but time and scientific investigation have always proved them to be subjective phenomena. My own observations certainly seem to support this view of the question; at the same time, my experience is small, for cases of "grave hysteria" are rare in Anglo-Saxon England, as compared to France with her Latin and Celtic races. Even Charcot declines to give a decisive reply to this question, but contents himself by drawing the conclusion "that the question is deserving of careful attention." He very properly points out that in such investigations one "should keep aloof as much as possible, both from the arbitrary scepticism which too often arises from pedantic ignorance, and from that naïve credulousness which characterises the charcoal burner's faith. It is between these two reefs, which are equally dangerous, that the observer must know how to steer."

Without wishing to give a hasty or decisive opinion on the matter, or to deny that subsequently another explanation may prove satisfactory, it must be admitted the above observations tend to show that the beneficial changes resulting from the application of metals to the skin are due rather to the mental effects they produce than to any special virtues emanating from the metals themselves. This is further supported by the following considerations:—

1st. These phenomena occur for the most part in women, and in persons of a hysterical temperament, who are proverbially prone to rapid and sudden changes readily induced by emotion or expectant attention.

2nd. None of the effects resulting from the application of metals are inconsistent with what is well recognised as the influence the mind possesses over the body.

3rd. The symptoms of anæsthesia and analgesia are so changeable and unstable as to render it difficult to say positively when they are directly affected by remedies. I have, for example, at present under my care in the wards of the Westminster Hospital a girl who frequently for hours

together has complete anæsthesia and analgesia of the right thigh. At other times her skin is perfectly normal, and this without any treatment or apparent cause. We have also no accurate physical means of measuring sensibility, and are for the most part dependent on the statement of the patient.

4th. The facts that (a) the action of the metals has been in the hands of the writer uncertain and inconstant, many of these inducing similar effects at different times, and any particular one causing diverse actions on separate occasions; (b) that no metal is apparently specially suitable for any given patient, for that which fails at one time may succeed at another; and (c) that no metal at all is required, discs of wood having produced all the alleged phenomena—would seem to indicate that the effects of metallothrapy are of mental and not of physical origin; and that, however highly endorsed, we should pause before accepting too readily a theory which appears to be only a revival of a long-exploded doctrine.

A STUDY OF FOUR HUNDRED AND FIFTEEN CASES OF TETANUS.

BY DAVID W. YANDELL, M.D.,

Professor of Surgery in the University of Louisville, Kentucky, &c.

SOME years back I collected from such medical journals, domestic and foreign, as were within my reach reports of three hundred and eighty-five cases of tetanus. To these were added thirty unpublished cases gathered from practitioners in this city, making a total of four hundred and fifteen cases. The work of tabulating and examining these was kindly done by my friend and colleague Prof. Cowling. The results obtained I propose to summarise here.

Of the total, two hundred and thirty-three cases recovered, one hundred and eighty-two died. It is apparent that for purposes of comparison such results are clearly worthless; but they serve to show that statistics on this point are as imperfect now as when Mr. Curling published his tables in 1837. This obviously arises, I think, from the practice of reporting recoveries only, deaths not being considered a matter of interest. In confirmation of this opinion, I have to state that of the thirty cases now published for the first time, 90 per cent. died. In the three recoveries, one went without treatment, except systematic nourishment; the second was brought through by a "Thompsonian" with steam and lobelia; while the third, having for its only symptom but a slight trismus, which disappeared after a little hypodermic atropia, cannot fairly be regarded as tetanus. Further, the character of the practitioners who treated these cases is an ample guarantee that everything was done which patience and skill

could suggest, the frightful mortality belonging simply to the history of the affection.

But though the tables before me are worthless as to aggregate deaths and recoveries, and are perhaps of no real value as denoting the comparative efficacy of different remedies, yet I think that in the lessons they teach it will be found that in more than one important particular, at least, they serve to throw light on tetanus, the date of its invasion and the duration of the tetanic symptoms, and the influence of these on the general result.

Sex.—This is stated in but 375 cases, 80 per cent. of these were males. The greater exposure of men to the exciting causes of tetanus is usually regarded as sufficient to explain this disparity, yet in 34 cases of idiopathic tetanus 70 per cent. were males. Of males, 44 per cent. recovered; of females, 58 per cent., or, excluding puerperal tetanus, 63 per cent. recovered. It will be observed that these results quite approximate those furnished by Mr. Curling, while they differ from those stated by Mr. Poland,¹ who finds a much greater preponderance of cases in males and of deaths in females.

Age.—The first decade of life furnished 7 per cent. of all the cases. Of these, 62 per cent. died. If prognosis in tetanus be influenced by age, it is less favourable at this period than between ten and twenty years, where the cases rose to 20 per cent., while the mortality fell to 38 per cent. The death-rate could not be made out in the remaining decades, owing to the large number of cases which were reported simply as adults. Fifteen cases are recorded as occurring in individuals over fifty years; and one case in a man aged eighty-nine is reported.

If this very striking difference in the death-rate of so large a number of cases is not a mere coincidence, it would seem very clearly to indicate that while tetanus is comparatively rare, it is also peculiarly fatal in persons under ten years of age; and if to this list the cases of trismus nascentium ending fatally be added, the percentage of deaths would be enormously augmented.

¹ Holmes's 'System of Surgery.'

The tables furnish nothing new as to the character of the wounds which are succeeded by tetanus. Wounds of the extremities and punctured wounds still cut the largest figure in this class of injuries. The popular belief that injuries of the foot are more liable than those of other parts to be followed by tetanus is quite confirmed as to punctured wounds in this situation—the large majority being inflicted by nails run into the foot. Yet the cases as a whole give but eighty-eight wounds of the foot against ninety injuries of the hand. There were twenty-eight instances of wounds of the upper extremities, exclusive of the hand, and sixty-seven in the lower extremities, exclusive of the foot. Wounds about the head are credited with twenty-eight cases; injuries of the trunk with four, chancre with one, abrasion of the cornea with one, while ten followed abortion. Neither the situation nor character of the injury seemed to exercise any influence on the prognosis of the disease. Forty per cent. of deaths followed wounds of the hand and 44 per cent. wounds of the foot. The death-rate in puerperal tetanus reached 90 per cent.

Date of Invasion.—A much more important point than either of the foregoing is the time at which tetanic symptoms appear. The disease supervened within two weeks after the injury in one hundred and ninety-six cases. Of these, 62.5 per cent. died. From the fourteenth to the twenty-first day, 17 per cent. of eighty-one cases were fatal. From the twenty-first till the forty-fourth day there were seventeen cases, of which 17 per cent. died. In cases occurring within seventy-two hours after injury, recoveries exceeded deaths as 14 to 11. In such as occurred between the fourth and the ninth day, deaths exceeded recoveries as 73 to 33—69 per cent. In cases beginning on the thirteenth day, deaths stood to recoveries as 7 to 3; but where tetanic symptoms were delayed till the fourteenth day, recoveries were notably in excess of deaths—23 per cent.

It is a source of regret that in more than one-fourth of all the cases the date of invasion is not given; but it has been recorded in a sufficient number, I think, to show both the difference between acute and chronic tetanus—the difference between the percentages themselves—and finally, how these

differ from the standard of 46 per cent. of total deaths. It is true that the date of invasion is not the only element of dissimilarity between acute and chronic tetanus. But it is an important one; the degree of tetanic symptoms, the muscles involved, pulse, temperature, &c., are others which should not be lost sight of; but which these tables fail to show with a fulness sufficient to warrant even an approximative conclusion.

Duration of Symptoms.—The tables confirm in the main the well-known aphorism of Hippocrates, that tetanus, when fatal, is nearly always so within the first four days after attack. Sir Thomas Watson suggested that the period be extended to nine days. The first notable diminution in death ratio, as shown in the tables, occurred in those cases which had survived fourteen days. From that period the recoveries were progressively in excess of deaths. To illustrate: in tetanus continuing four days, eighteen cases give 50 per cent. of deaths; continuing nine days, there were one hundred and thirty-one deaths to thirty-nine recoveries, while in one hundred and five cases continuing from the ninth to the twenty-third day, there were eighty-two recoveries to twenty-three deaths. In seventy-four cases which survived beyond the twenty-third day but three died, death occurring in each on the twenty-eighth day. The largest number of deaths, thirty-one, fell on the second day. On the fourth day there were twenty-one deaths. There is a marked falling off in deaths on the fifth day, when there were but eleven deaths; from this time the percentage of deaths steadily diminished. The longest duration of symptoms is two hundred and forty days; the shortest, ending in recovery, is alluded to in the beginning of this article; the shortest in death, is in a few minutes. Nine cases lasted forty-two days; eighteen cases lasted thirty days. Between these two periods we find nineteen cases. Sixty and ninety days are also represented.

The Pulse and Temperature.

These have been recorded in too small a number of instances to admit of any deductions.

Dr. Radcliffe (Reynolds's 'System of Medicine') has stated

that there is an absence of fever in tetanus, and explains the heat and frequency of pulse, when they occur, by the dyspnœa, which urges the skin to take on compensative action. In three cases in which the temperature was recorded, and published now for the first time, the mercury rose to 106°-107°. They were all fatal. In two other cases, also fatal, observed by the writer, the pulse was one hundred and twenty from the beginning of the attack.

Treatment.

This is a matter which has been so varied and so complicated in different cases as to set at defiance all efforts at anything approaching accurate tabulation. The bare enumeration of the remedies used would more than fill one of these pages. Selecting the fifty leading agents to which recoveries are credited, it will be found that in a very small number of cases indeed has the treatment been trusted to a single agent alone. In the large majority of instances very varied combinations of the most powerful along with the least active agents in the Pharmacopœia were made, whereby it was rendered quite impossible to decide what part was played by either in the cure. In the following case, for instance, which I may add is but a type of many such found in the tables, the cure is credited to the subcarbonate of iron:—V. S. 3 xvj.; electuary of subcarb. iron and turpentine; emp. vesic. over epigastrium, enemas of turpentine, friction with camphor liniment, tonics. Certainly no one can believe that either of the agents mentioned exerted the slightest influence over the course of the disease.

In order to determine as far as possible the relative value of the various plans of treatment practised, everything which seemed to possess any real power has been carefully noted; also the percentage of recoveries under each; the number of recoveries occurring in cases where tetanus followed within nine days after the injury, the number of recoveries where the disease continued less than fourteen days; and finally the mortality in cases where the date of invasion was over nine days after injury, and where the disease continued beyond fourteen days.

The importance of viewing the management of tetanus from this standpoint will be found in the fact that a careful study of these tables goes, I think, to show that the *results* of treatment by the different remedies are so nearly the same *that no one agent can justly be said to possess a decided superiority over any other.*

The mere number of hours or days which intervene between an injury and a subsequent attack of tetanus, is, I am aware, but one of the characteristics which distinguish acute from chronic tetanus; but it is, perhaps, the very heaviest factor in any attempt to estimate the effect of treatment and the comparative value of the remedies used. I think that without it no correct opinion can be formed as to the part which any individual agent, or which treatment, as a whole, plays in the management of the disease.

In order to economise space rather than because it adequately portrays the several features whereby acute is known from chronic tetanus, I shall in what follows designate that form of disease which supervenes within nine days after the injury as acute, and that which occurs subsequently as chronic tetanus.

Aconite.—Fourteen cases; all chronic; 8 per cent. recovered; none recovered before fourteen days.

Amputation.—60 per cent. of seventeen cases recovered; four acute; four in less than fourteen days. Three chronic cases died, and one after fourteen days.

Bleeding.—55 per cent. of fifty-eight cases recovered: nine acute, ten before the fourteenth day. Seven chronic cases died, and two after fourteen days.

Calabar Bean.—39 per cent. of recoveries in thirty-nine cases. One recovery only occurred in the acute form of the disease. In five others recovery took place before the expiration of fourteen days. *Per contra* ten cases of chronic tetanus proved fatal.

Chloroform relieved 70 per cent. of thirty-five cases, nine of which were acute, and eight recovered before fourteen days. Three chronic cases died, and two after symptoms lasted fourteen days.

Cold Effusion.—73 per cent. of eleven cases recovered; three acute; three before fourteen days. Two chronic cases died.

Division of nerve relieved 75 per cent. of three cases: one acute; one before the fourteenth day. One chronic case died.

Ether.—6 per cent. of fifteen cases recovered: five acute; seven inside of fourteen days. One chronic case died.

Indian Hemp.—Used in twenty-five cases, with 64 per cent. of recoveries, of which three cases were acute, and six recovered before the symptoms lasted fourteen days. One chronic case died, and one after fourteen days.

Ice-Bags.—77 per cent. of nine cases recovered: one acute; two in less than fourteen days.

Mercury.—57 per cent. of seventy-five cases got well: eight acute; twelve before fourteen days. Seventeen chronic cases were lost, and two after fourteen days.

Opium.—57 per cent. of 165 cases recovered: twenty-two acute; twenty-nine before fourteen days. Twenty-six chronic cases were lost, and four after the disease had continued fourteen days.

Purgatives.—66 per cent. of seventy-four cases recovered: thirteen acute; twelve before fourteen days. Ten chronic cases died, and three after fourteen days.

Quinine.—73 per cent. of fifteen cases recovered: one acute; three before fourteen days. Three chronic cases ended fatally, and one after fourteen days' duration.

Stimulants.—8 per cent. of thirty-three cases recovered: four acute; six within fourteen days. Six chronic cases died, and three after fourteen days.

Tobacco relieved 50 per cent. of forty-one cases; six acute; six before fourteen days of the disease. Four chronic cases died, and one after fourteen days.

Turpentine relieved 70 per cent. of sixteen cases: six acute; four before fourteen days. Five chronic cases died, and two after fourteen days.

I think these facts certainly show, as far as they go, that we are not improving in our treatment of tetanus. Chloroform ranks in these tables as the most efficient agent yet known in acute tetanus; while even mercury and venesection, which belong to a past age, excel the Calabar bean, of which so much

was expected, not only in general results, but in power of control over the disease in its acute form. An astonishing fact is that in the long list of remedies there are but three—musk, woorari, and warm baths—where the percentage of recoveries was less than by the Calabar bean; and even here the first and last of this trio effected an equal number of cures of acute tetanus. It is but just to the friends of the bean to say that these tables were prepared when the effects and doses of this drug were not so well understood as at present; yet in nine cases of tetanus seen by the writer since that time, and all treated by the bean and chloral hydrate, the percentages remain quite the same. The conclusions which a careful review of the tables would seem to warrant may be summarised as follows:—

I. That traumatic tetanus is most fatal during the first decade of life.

II. That it usually supervenes between four and nine days after the injury.

III. That the largest number of recoveries are found in cases in which the disease occurred after the lapse of nine days from the injury.

IV. When tetanus continues fourteen days, recovery is the rule and death the exception, *apparently independent of the treatment.*

V. Tetanus arising during the puerperal state is the most fatal form of the disease.

VI. Chloroform has up to this time yielded the largest percentage of cures in acute tetanus.

VII. The true test of a remedy for tetanus is its influence on the history of the disease: (a) Does it cure cases in which the disease occurred prior to the ninth day after the injury? (b) Does it fail in cases whose duration exceeds fourteen days?

VIII. Tried by these tests, no agent has yet established its claims as a true remedy for tetanus.

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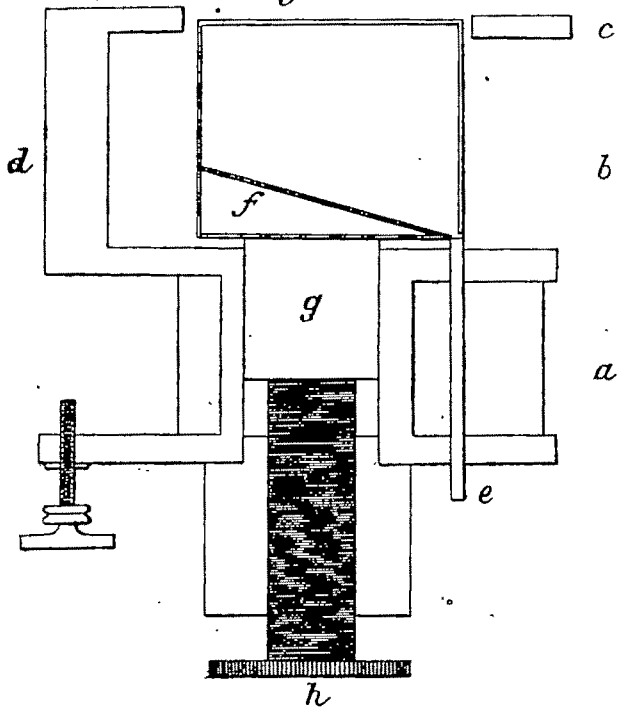
APPLICATION OF FREEZING METHODS TO THE MICROSCOPIC EXAMINATION OF THE BRAIN.

BY BEVAN LEWIS, F.R.M.S.,

Pathologist and Assistant-Medical Officer, West Riding Asylum.

THE adoption of freezing methods for the purpose of obtaining sections of the tissues in a perfectly fresh state has proved an invaluable boon to histologists. Of all processes that of freezing must be regarded as the most elegant and trustworthy for this purpose; and great as has been the success achieved by the use of hardening reagents, such as alcohol, picric acid, osmic acid, and chrome salts, it must be admitted that the most reliable information can only be obtained by examination of tissues in the fresh state. Such preparations form the most trustworthy standards of comparison with which we should habitually contrast results obtained by the employment of chemical reagents. We can by no means afford to dispense with the chrome-hardening processes in studying the central nervous system; it is an old and valued friend, reliable in certain spheres of action, yet often misapplied—made use of for purposes to which it was never adapted, issuing in results of the most confusing character, and receiving from critics that ill-merited opprobrium with which the thoughtless microscopist should alone be credited. In the present state of microscopic science it appears to me scarcely justifiable for an original investigator to limit himself to any single method in the examination of the elements of the nervous system, nor can any of us hope to possess authoritative claim to hearing for results obtained by the exclusive employment of either the hardening or the fresh methods of examination. Nowhere

Fig. 1.



is more attention paid to the truth of what I here assert than in that unrivalled work of Ranvier's, lately published,¹ in which the student is led to pay due attention to every possible method of inquiry, and to compare with critical severity their comparative results.

Our handbooks teem with descriptions of the most approved methods of preparation by hardening reagents, but I cannot recall to mind any description of the method to be adopted for examining the brain in sections obtained by freezing, and I therefore purpose describing the method adopted by myself, feeling convinced that it will be fully appreciated by those who have up to the present employed the tedious processes of chrome hardening, and suffered, as I have personally, from the numerous disappointments attendant upon the exclusive use of this method. It appears to have been the opinion of several microscopists who have employed the chrome salts exclusively, that the freezing method was wholly inapplicable to the investigation of the central nervous system, and several authorities in cerebral histology had expressed to me such an opinion. Results obtained by at least one German observer and my own work at the West Riding Asylum prove this view to be incorrect.

The Freezing Microtome.—I was led to the employment of ether for freezing tissues, after having experienced numerous difficulties in the use of the ice and salt mixture. The process was so tedious that a more expeditious method appeared desirable, and I therefore constructed an instrument for freezing with ether spray, and described it in the *Journal of Anatomy and Physiology*, for April 1877. At this time I was informed that an instrument was described by Mr. Hughes in the same Journal, twelve months previously; but finding my microtome simpler in construction, and more expeditious in freezing, I have employed it, with some slight modifications, up to the present time. The woodcut opposite (Fig. 1²) represents in vertical section the freezing microtome which I constantly employ, and which I can very strongly recommend for general use. The lower half (a) is in principle an ordinary Stirling

¹ 'Leçons sur l'Histologie du Système Nerveux,' par Ranvier.

² This instrument can be obtained from Mr. Gardner of Edinburgh.

microtome; the upper half consists of a freezing chamber (*b*) and the section plate (*c*). As regards the microtome, I always insist upon the use of an oval instead of a circular plug (*g*), whilst the screw should be $\frac{3}{4}$ of an inch in diameter, finely worked, and with a milled head at least $\frac{1}{2}$ of an inch wide. The freezing chamber (*b*) should have a false sloping bottom, (*f*) leading to an exit tube (*e*), which conducts off the condensed ether. Extremely simple as this contrivance appears, it is absolutely necessary for success that attention be paid to the following details of construction. The freezing chamber consists of a large hollow cylinder of zinc, slightly over two inches in diameter, and capped with a plate of the same metal. This cylindrical chamber is soldered on to the microtome plug, so as to insure absolute steadiness in working, and it possesses three circular openings, $\frac{3}{4}$ of an inch in diameter, one placed in front of the two others laterally opposite each other. The section plate (*c*) is also made of zinc $\frac{3}{16}$ ths of an inch thick, and raised upon the vertical arm (*d*); also made of the same metal. The opening in the section plate should be sufficiently large to allow of the free play of the freezing chamber (*b*) through it without affording any point of contact between the two. With a freezing chamber such as the one described, beautifully large and thin sections may be obtained with ease. The material employed in the construction of the freezing chamber and section plate is a matter of importance, and I met with frequent failures and disappointments when endeavouring to utilise other more workable metals. Brass, above all other metals, was found unsuitable, and zinc alone fulfilled all the requisite conditions. Theoretically it was supposed that the metal chamber should be covered with a non-conducting material, such as felt, wood, &c., and that the conduction between the section plate and body of the microtome should in like manner be cut off; but practically it was found that at the sacrifice of a small amount of ether rapid freezing could be insured and a large number of sections obtained before the tissues became loosened from the freezing chamber. It should be remembered that, to avoid the expense and incumbrance of a special condensing apparatus, we have to provide for the free evaporation and subsequent condensa-

tion of ether in the same chamber, and consequently a sacrifice of about one-fourth the bulk of ether used is sustained. I regard as the requisite of a good freezing microtome the following conditions:—

1. The instrument should be of the greatest possible simplicity.
2. The freezing should be rapid and expeditious.
3. The metallic constituents should be such as to retard thawing of the tissue when once frozen.
4. A minimum of ether should be expended.

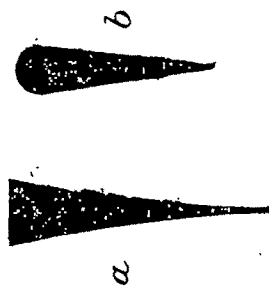
Now I would claim for my instrument a fulfilment of these conditions, as far as is possible, without the employment of an exhausting and condensing apparatus; and I would on these grounds advocate its use by those who require a most satisfactory microtome, and one comparatively inexpensive. The first condition, that of simplicity, is too self-evident to dwell upon; the second also is insured, as the tissue is frozen in less than twenty seconds, whilst it remains adherent to the cover of the freezing chamber for a period sufficing for the cutting of a dozen sections or more. A very small quantity of ether suffices for freezing, and three-fourths of its bulk becomes condensed, and may be collected in a bottle attached to the tube (*e*). I use a graduated bottle for the ether spray, and can thus read off the amount of ether expended in freezing. The costliness of ether has been urged against its employment in ordinary section cutting by one authority of note, and the objection would prove of great weight in case a large amount of ether was lost at each operation; it is but necessary, however, that the instrument be once seen in good working order to dispel all such notions from the mind, as the results obtained are of the first order, and the expenditure of ether very trivial.

Method of Cutting Sections of Brain.—The freezing chamber is lowered until the cap is level with the under-surface of the section plate, and a portion of the tissue, somewhat thicker than the section plate, is laid upon the centre of the metal cap; a couple of drops of water are placed along its edge, which, when frozen, forms a substantial bed, to which the tissue firmly adheres. The nozzle of the spray instrument is now introduced through the opening in the left-hand side of the freezing

chamber, and the spray made to play upon the lower surface of the cap, immediately beneath the tissue to be frozen. A cool draught of air should be allowed, if possible, to play over the surface of the section plate, as it renders freezing still more expeditious. In a few seconds a white band appears at the junction of the tissue and the metal cap, and this rapidly spreads upwards until the tissue becomes blanched and frozen throughout. I invariably freeze up to the level of the section plate, then, with one sweep of the knife, I remove the unfrozen layer above, and so obtain a smooth surface from which to take my sections. A large glass vessel (such as is used for mounting the larger pathological specimens in museums) should be at hand, half-filled with water, and the blade of the section knife dipped into it previous to cutting each section. The lower surface of the blade should be passed rapidly over a towel supported on the knee, whilst its upper surface should be allowed to retain a sufficient supply of fluid to float up the section as it is cut. Each section when obtained should be floated off into a vessel containing water. It requires but little skill for the operator to obtain by this method a dozen or more exquisitely fine sections before it is necessary to reapply the spray. The rapidity with which such results are obtained are certainly modified by the temperature of the atmosphere; but with a temperature below 60° Fahr. and in a cool current of air the results will always prove most satisfactory. In extremely cold weather we often find that a little water running off the blade becomes frozen on the section plate, resulting in an uneven surface which wholly prevent section cutting. This obstacle is readily overcome by the use of a little dilute glycerine smeared over the surface of the section plate, care being taken not to extend it to the cap of the freezing chamber.

The Section Knife.—All histologists who have used the hardening methods for obtaining sections of brain and spinal cord will, I think, agree with me when I state that the form of knife used is an important agent in the success of the operation. Thus, when the flat of the blade is placed on a perfectly level surface, the back and edge of the knife should assume *exactly the same plane*. The surface of the blade which is uppermost in section cutting should be sufficiently concave to retain a

Fig. 2.



fair amount of fluid for floating up the section. Frequent stropping is also indispensable, as the blade should be kept worked up to the finest possible edge. All these conditions must be kept in view when cutting hardened or frozen tissues; but, as the texture of the latter is always such as is most favourable for obtaining the very finest sections, we shall meet with no difficulties in the use of our knife on the freezing microtome—in fact, the discouragements which meet all beginners who attempt section cutting from hardened preparations are wholly absent here, the operation becoming one of the greatest simplicity, wholly independent of any acquired skill. The blade which I almost invariably use measures 5 inches in length by $1\frac{1}{4}$ inch in width. It is made of the best steel, and is concave on both surfaces, but most hollowed out on the surface which is uppermost in section cutting. I add a sketch of a good blade and a section, giving its curved surfaces (Fig. 2, *a*). In the same figure (at *b*) is represented the curved surface of a smaller blade, measuring 4 inches by 1 inch.

Subsequent Treatment of Sections.—We will suppose that we have obtained by the method above described a number of sections cut vertically through the cortex cerebri, and have floated them off into a vessel of water. Each section is now carefully floated on to a glass slide and placed beneath a shade, covering it from dust, the superfluous water being drained off the slide.

a. Osmic Acid Treatment.—A solution of osmic acid, .1 to .2 per cent. should be taken up in a pipette, and two or three drops allowed to fall over each section. The osmic acid should be left to exert its action under cover for ten to fifteen minutes, and the sections immediately afterwards floated off in water to rid them of superfluous acid.

b. Staining by Aniline.—The films of brain substance are again received upon the slides and are ready for staining. I employ for this purpose a solution of aniline black—25 grammes of the granular powder to 100 cb. cm. of distilled water. The solution must be carefully filtered before use. This solution should be poured by means of a pipette on to each slide and over the sections, which become satisfactorily

stained in the course of half an hour to an hour. When it is important to localise each section afterwards, the films should be stained as above on numbered slides, but where such precautions are unnecessary, they may all be stained simultaneously in a porcelain capsule. The aniline solution may now be removed by means of a pipette or syringe, and the films once again floated into a vessel of water; a slight agitation suffices to wash them thoroughly. In this stage, or in the earlier stage, after washing off the superfluous osmic acid, these films form most reliable and excellent preparations for studying the arrangement of the nervous elements in a fresh state, and for the application of reagents in the histo-chemical examinations. For permanent preparations the following process is necessary:—

c. Mounting for Permanent Preparations.—The slides on which the stained sections are placed are now covered by a bell glass, having also introduced beneath it a porcelain capsule containing concentrated sulphuric acid. The sections are thus dried in a fine and perfect film upon the slides in the course of a few hours. A little Canada balsam (dissolved in benzole) is then dropped upon the section and the cover glass adjusted. Such preparations exhibit the structure of the cortex cerebri with a distinctness and beauty unrivalled by any other process which I have seen adopted. Were I to examine critically the various stages of the process now described, and give reasons for the employment of each measure adopted, I should but summarise the many failures and disappointments which I have met in my endeavours to perfect the process. It will, however, prove instructive to note a few facts connected with the history of this process, as they may prove landmarks for the guidance of others. First, then, as to the employment of osmic acid—to what object is it subservient?

Use of Osmic Acid.—If a section of brain be placed beneath a cover glass, separated only by a slight film of water, and examined by a quarter-inch objective, it will soon be apparent that the medullated nerve fibres become greatly altered, as is the case in the peripheral nerves. Myeline exudes around them in its varied and characteristic forms, and eventually the

axis-cylinder becomes perfectly naked and uncovered by the white matter of Schwann throughout its whole extent. If the surface of the cortex *immediately beneath the pia mater* be examined, we observe the same changes taking place in the band of *medullated fibres* which run parallel with the surface of the cortex to the depth of one-third the extent of the first cortical layer. The result is readily conceived. The first layer of the cortex is rendered extremely friable, can only be preserved in fragments, and this with much difficulty; the white matter of the brain is reduced to the same state, and if not carefully agitated and *freed from the abundant exudate of myeline cannot be stained*. Now this simple circumstance afforded me at first much perplexity. What I required was a reagent which, whilst preventing this change in the nerve tubuli, should not interfere with the due staining of the other nervous elements, or alter their delicate relationship. Alcohol and many other reagents were found inadmissible, but in osmic acid I obtained all the requisite conditions. This acid in an extremely dilute solution coagulates the white matter of Schwann, and preserves most perfectly the relationship of the various histological elements of the tissue, nor does it in any way interfere with the subsequent staining by aniline. One word of caution, then, to the histologist. Do not leave your sections of fresh brain in water longer than you can possibly avoid, and counteract its destructive tendencies by the employment of osmic acid.

Aniline Staining—Conditions essential to success.—It will be found that the immediate treatment of fresh sections by aniline black tends to reduce their consistence, that exposure to the action of more concentrated solutions or even the prolonged action of a .25 per cent. solution will equally result in rendering the film extremely friable and eventually reduce it to a pulpy stringy mass. This is due to the same result, the destructive action in the nerve fibre which proceeds far more rapidly than under the agency of water alone. The greatest difficulty is consequently experienced in washing the preparation from the superfluous reagent, and the increased friability is fatal to all subsequent treatment of these films of nervous tissue. Here again the agent which neutralises the detri-

mental action of the aniline dye is osmic acid, and the consistence of the sections becomes so modified by its employment that staining to any extent by aniline may be adopted, the sections freely washed and manipulated with but little fear of tearing their structure, however delicate in tenuity. In fact, the osmic acid becomes here a reagent of the utmost importance, as we are enabled by its use (a) to ward off the destructive action of other fluids on the medullated nerve; (b) to give these delicate films the consistence requisite for subsequent staining and manipulation; (c) to preserve the normal appearance and relationships of the histological units—conditions which could not be insured by the aid of alcohol and other reagents. We do not in these permanent preparations preserve the dark staining of the medullated tubes characteristic of the osmic acid reaction such as would appear if our sections were mounted in glycerine. Why then do we not employ glycerine in lieu of the process of desiccation? The reason is obvious—glycerine is a powerful solvent of aniline black, nor have I up to the present time succeeded in fixing the dye sufficiently to resist the solvent power of this reagent. But there are limits to the power of aniline black as a staining reagent, and it is essential to give due consideration to this fact. By its agency the nerve cells are rapidly stained, the nuclei taking a deeper tint, whilst the processes are beautifully portrayed, the minutest nerve fibrils faithfully represented, so that the ramifying branches arising from the basal angles of the cells of the cortex are exhibited with extraordinary distinctness. It will be found, however, that connective elements of the neuroglia stain far less readily, assuming a paler tint, whilst the perivascular nuclei are deeply tinted. Then again the medullated nerve fibres before and after entering the cortical layers, as well as that band of double contoured fibres coursing along the outer or peripheral zone of the cortex, remain wholly unaffected by this reagent. Consequently an examination of the white matter of the brain shows us the vessels, their nuclei, and the connective cells as the only elements stained. This, at first sight, may appear strange, since there is no reason for doubting the identity in constitution of the axis cylinders of these fibres and the deli-

cate processes given off from the apex and basal angles of the nerve cells which are so distinctly mapped out by this reagent. A satisfactory explanation, however, can be afforded. If our sections be allowed to remain some hours in water prior to staining, it will be found, on examining the mounted preparations, that the white matter no longer presents the bare appearance above indicated, but is rich in dense bundles of most delicate fibrils running parallel in rectilinear or curved directions towards the cortical layers. Many of these fibrils are broken and curled upon themselves, but the vast majority sufficiently well indicate their nature and their normal relationships.

These fibres are naked axis cylinders beautifully stained by aniline, and afford an instructive study to the histologist. The successful staining is wholly due to the prolonged action of water, whereby the white medulla of Schwann has been removed, which previously formed a powerful obstacle to the admission of the aniline reagent. In recommending this method for the preservation of sections of the cortex cerebri it will be understood, from my former remarks, that I by no means regard such work as the equivalent or substitute of direct examination of the fresh film. Such observations are of incalculable value, and should never be omitted, as they afford information which can often not be obtained from the permanently mounted specimens, and, with a little experience in their manipulation, the nervous, connective and vascular elements may be displayed in all their integrity and beauty.

Relative Merits of Chrome and Fresh Methods.—In advocating the above method for the preparation of the cortex cerebri, I would wish to state a few facts which I believe clearly indicate its superiority to older processes in some very important particulars. In the first place, we must regard it as an expeditious and ready method for the examination of fresh tissues, involving the sacrifice of a minimum of time, whilst securing results of a most reliable character. Should our object be to examine these tissues in a fresh and unprepared state, the films cut from frozen brain afford us the best material both for subsequent testing and for histo-chemical research. If on the other hand we desire to secure permanent specimens, the method

advocated will ensure excellent results. Do any special advantages pertain to this method which we do not obtain by means of preparations hardened in chrome? To this query I may reply very decidedly in the affirmative. Thus it is an indubitable fact that the cortex cerebri is greatly diminished in depth by chrome hardening, frequently being reduced to one-half the depth shown by the method which I adopt. By the latter, in fact, we obtain the natural depth of the cortex, no shrinking occurring if the preparations have been carefully made. Actual measurements, however, must determine this point, and the subjoined table gives the results of comparison of the depth of the cortex in hardened and frozen specimens:—

<i>Average depth of cortex</i>	Man.	Cat.	Calf.	Sheep.
In hardened brain	2-2.5 mm.	1.5 mm.	1.2 mm.	1.55 mm.
In frozen brain	4.836-5.7 „	2.6 „	2.04 „	2.6 „

The depth of cortex in man, the cat, and calf, given above, for hardened preparations, is quoted from Meynert, and the table represents in a marked manner the degree of shrinking undergone in the chrome hardening. This is a matter of great importance, when we consider that, as we descend in the scale of mammalia, we recognise a relative increase in depth of the first layer to the whole depth of the cortex. Meynert supplies us with a list illustrating this important fact, but on contrasting a few of such data with those presented by the frozen specimens we find the point comes out still more forcibly as shown by the following table:—

<i>Hardened by Chrome.</i>	Man.	Cat.	Calf.	Sheep.
Absolute depth of first layer ..	209 mm.	348 mm.	40 mm.	441 mm
Relative depth to whole cortex	$\frac{1}{8}-\frac{1}{10}$ „	$\frac{1}{2}$ „	$\frac{1}{2}$ „	$\frac{1}{2}-\frac{1}{3}$ „
<i>Frozen Preparations.</i>				
Absolute depth	279-348 mm.	348 mm.		441-558 mm.
Relative depth	$\frac{1}{8}-\frac{1}{10}$ „	$\frac{1}{2}-\frac{1}{3}$ „		$\frac{1}{2}-\frac{1}{3}$ „

A glance at this table reveals the fact that, whilst chromic acid and its salts act powerfully in the direction pointed out, they also affect the cortex of various animals to a very different extent, the degree of shrinking varying with each animal. But apart from the consideration of this corrugating action of chrome reagents, another important fallacy is introduced. In no preparations made by this method have I ever been able to

see the same wealth of structure which is shown by the specimens mounted by the fresh method. Here we find the nerve cells far more crowded and their processes more numerous, more distinct, and more complicated than seen in a corresponding section prepared by the chrome method. Careful examination of this point has led me to the decided opinion that the older method fails to show us anything like the richness of nervous structure which should be seen in our sections, and is certainly antagonistic to the exhibition of the complicated branchings of the various groups of nerve cells. The cells also are stunted, unnaturally angular, and those of the second and third layer present appearances often very different from what is seen in the perfectly fresh section—these appearances, however, being very accurately preserved by the process which I adopt. The disadvantage connected with the process—the want of staining of the medullated fibres running up from the white matter—has been already dwelt upon, as well as a method whereby this difficulty is partially removed. Both old and fresh methods should undoubtedly be employed in examination of the brain cortex, but the ease and rapidity with which results are obtained by the latter will recommend it to histologists for application on a far more extensive scale than would be possible by the older methods.

THE SYMPATHETIC CENTRE.

BY W. HENRY KESTEVEN, M.R.C.S.

Is there a centre from which the vaso-motor or sympathetic nerve force originates in the medulla oblongata or spinal cord? The above question assumes the assertion of the existence, by physiologists, of such a centre. There must be, it is therefore inferred, some grounds on which such assertion takes its stand. Before any attempt be made to answer the question, it will be as well to examine the grounds of the views here implied.

Turning to the writings of those who have asserted its existence, we find that their conclusions are mostly founded on the results obtained by experiments on living animals. One of the most modern writers on the subject, Dr. Julius Althaus, gives expression to these views, in his work on Nervous Diseases, in the following words:—"The chief vaso-motor centre is situated in the medulla oblongata, but there are minor centres for the blood-vessels throughout the entire length of the spinal cord. Faradisation of this organ causes constriction of all arteries below the seat of irritation, while destruction of it produces dilatation of the same, likewise below the seat of lesion. The vaso-motor centres appear to be situated in the anterior cornua of the grey substance of the cord, and the vaso-motor nerves coming from them proceed from the lateral columns through the anterior roots of the spinal nerves to the periphery. That such centres exist all the way down in the cord is shown by the following phenomena: After the arteries have for some time remained distended from section of the cord, they contract again, so as to resume their normal diameter, when the effects of shock, and consequent paralysis of the lower centres, have passed off.

Every further section of the cord lower down causes the same phenomena, viz. at first dilatation, and afterwards contraction, of the arteries. Even after destruction of the lumbar cord, the blood-vessels of the hind parts do not remain permanently or completely paralysed: and we are therefore led to the conclusion that, independently of the vaso-motor centres in the medulla oblongata and the spinal cord, there are local ganglionic centres in the vessels themselves, analogous to the motor ganglia of the heart, which still cause rhythmic contractions of that organ after it has been severed from its centre in the medulla oblongata, as well as from the sympathetic and pneumogastric nerve. After destruction of the higher centres, the lower, and also the peripheral centres, seem to gain in power, through the increased quantity of blood contained in the vessels after such operations."

The above quotation has been selected because it represents the most modern phase which the question has assumed. Subsequent remarks must be considered as directed against the views therein expressed. The first point to be remarked is that the conclusions arrived at are founded on the results of experiments which must at least be regarded as destructive of vital processes. The condition, for scientific purposes, of any animal who has repeated sections made across its spinal cord must, to say the least, be rather anomalous. Taking, however, the conclusions which have been arrived at, it is here meant to be maintained that the results do not warrant the before-mentioned deductions, *e.g.* 1st, that there is a vaso-motor centre in the medulla; 2nd, that there are other vaso-motor centres all down the cord, inferred to be in the anterior cornua; 3rd, that there are local ganglionic centres in the vessels themselves, this conclusion being partially founded on analogy; 4th, these peripheral centres seem to gain in power after the destruction of the higher centres, through the increased quantity of blood contained in the vessels after such operations.

The last of these conclusions is somewhat dependent on the foregoing one, in so far as the existence of the ganglionic centres in the vessels is taken for granted.

The results of experiments on which all the above inferences

are grounded, are the constriction of all the vessels below a point faradised, and dilatation of the vessels below a point cut across or otherwise destroyed. If the above results can be shown to be explicable from another point of view the conclusions must at least be weakened.

A study of the connections which exist between the cerebro-spinal and vaso-motor systems seems to reveal another and, as it appears to the writer, a more rational explanation of the above results. It is well known that what is called the sympathetic nervous system consists of a double chain of ganglia arranged on either side of the anterior aspect of the vertebra, these ganglia all giving off nerves which are distributed throughout the system in more or less complicated connection with the nerves of the cerebro-spinal system.

The connections existing between the two systems may well be described as complicated. Without, however, going into any very elaborate descriptions of these connections, it is sufficient for present purposes to divide them broadly into two classes, *central* and *peripheral*.

The *central* are those which unite the ganglia of the sympathetic chain or trunk with the cerebral spinal nerves, called the Rami Communicantes. The *peripheral* are those which exist, as their name implies, between the various nerves passing from either centre. The great point to be observed with regard to these connections is, that at no place does real union take place between the systems without the interposition of nerve corpuscles. The nerve fibres may run together, that is, in the same direction, but they are never actually united unless the nerve corpuscles intervene. Such intervention of corpuscles gives rise to secondary ganglionic formations. These formations vary in accordance with the number of nerve fibres which have to be united. The otic and submaxillary ganglia are instances of small ganglionic formations; but where this coalescence takes place in the neighbourhood of some large viscus, the ganglionic formation is more complex, and has received the name of plexus. Without here entering further into the anatomy of the subject, we pass on to the object which is aimed at and attained by means of their various and complicated connections.

And now the question as to the nature of the force which, taking its origin in the nerve corpuscles, causes the various forms of motion which are necessary for the due carrying on the animal economy, requires to be considered. Dr. Radcliffe, in his work on Vital Motion, proves that "*nerve force*" (so called because those words might mean anything) is simply electricity. It may be said that the change of names has not thrown much light on the subject, but the word *electricity*, although in itself only meaning a force derived from *ἤλεκτρον*, implies at least a force with the characteristics and mode of action of which we are better acquainted than with the indefinite properties of what was called nerve force. Dr. Radcliffe has shown that in a state of rest both nerve and muscle are in a state of charge analogous to that of a charged Leyden jar. *Action is discharge.*

Such is the main result brought out in the work above referred to.

Taking, then, this view of the power which causes the movements requisite to life, we next inquire what is its mode of action. More particularly, How do the sympathetic ganglia fulfil their part in the general economy?

First, with regard to the electro-nervous charge which exists in a state of rest.

This state of charge in the ganglia of the sympathetic trunk is derived from the cerebro-spinal system by means of one of the Rami Communicantes, and to a certain extent is self-existent. It is by these means that the nerve corpuscles of the sympathetic derive their power of action or electro-nervous force. It is, however, one of the functions of all nerve corpuscles to cause modification of the impressions brought to them. The peculiar modification which the nerve corpuscles of the sympathetic cause in the electro-nervous force thus derived from the higher or more specially developed cerebro-spinal system, consists in enabling that force to act upon the involuntary muscular fibres throughout the body. This, then, is the object of the central connection between the systems, the supply of electro-nervous force for the modification rendered necessary for the attainment of the functions of the sympathetic system, viz. contraction of the involuntary muscular fibres.

As, however, it has been shown above, this central connection is not the only one existing between the two systems; there is also a series of peripheral connections. That these latter are as important as the central connections is shown by the fact that, as regards the sympathetic system, they are universal. *That is, there is not throughout the body a single sympathetic nerve fibre which reaches its destination without previous admixture or fusion to a certain extent with nerve fibres from the cerebro-spinal system.* This fusion or admixture is brought about by means of the various ganglia and plexuses which are scattered throughout the body.

The object of such fusion is that the force which is distributed from the central sympathetic ganglia may be controlled. How this control is accomplished cannot be conclusively determined. One explanation which appears feasible is, that at these points of fusion there meet, under certain circumstances, two currents of force. The result of such meeting may be, supposing the forces are equal in all respects, a complete stoppage of both currents, or, if one or the other preponderates, there will be a result corresponding to the preponderance. Whatever may be the *modus operandi*, the result as regards the sympathetic is certain. The peculiarly modified electro-nervous force has not an unlimited or uncontrolled power of action. It is easy to see that were this the case there would be a condition of block throughout the system, a complete arrest of all the natural processes.

Taking, therefore, this explanation of the conjoint action of the cerebro-spinal and sympathetic systems as a stand-point from which to view the results obtained by the experiments mentioned above, it will be seen that they are capable of another explanation.

It is presumed, in the conclusions above quoted, that faradisation causes constriction of the vessels by the stimulation of a supposed vaso-motor centre; and that section causes the reverse, by destruction of, or separation from, the supposed centre. If, however, the state of rest is considered to be, as proved by Dr. Radcliffe, a state of charge, faradisation is likely rather to maintain that state of charge, and, therefore, to prevent action in the parts faradised. As has been shown above, if the action of

the cerebro-spinal nervous current is stayed, that current coming from the sympathetic ganglia in answer to the regular normal stimulation will acquire preponderance. In other words, the involuntary muscular fibres of the blood-vessels will be contracted. In the case of section or destruction in the cerebro-spinal centres, any one who has ever killed a fowl by breaking its neck, and so crushing the medulla, must have been convinced that electro-nervous discharge results, causing violent general convulsions. The cerebro-spinal nervous current in this case acquires preponderance, the result is dilatation. If the destruction be not in a vital point of the cerebro-spinal system, there is nothing to prevent the sympathetic nervous current resuming its share of power when the discharge has passed off. Nervous centres, such as are described in the third conclusion, have never been demonstrated. The existence of such in the heart is not sufficient evidence, unless the necessity for them in the vessels can also be shown. From the above point of view such does not exist, nor does the gain of power in the peripheral centres after destruction of portions of the cerebro-spinal system require to be accounted for by the increase in the amount of blood.

In conclusion, then, it may be said :—

That there is not a direct vaso-motor centre to be found either in the medulla or in the cord.

There is also every reason, on the above grounds, to doubt whether there is any truth in the supposed existence of a centre specially regulating the production of body heat.

Critical Digests and Notices of Books.

Insanity in Ancient and Modern Life, with Chapters on its Prevention. By DANIEL HACK TUKE, M.D. Macmillan, 1878.

WE doubt whether the interest in this work will be as general as it would excite if the accuracy of the statement expressed in the opening paragraph were acceptable to the foot of the letter.

"A remarkable feature of the present day is the interest felt by the public at large in questions relative to insanity. So far from its being confined to the medical profession, legislators, lawyers, clergymen, sociologists, metaphysicians, have their attention forcibly drawn to the subject, and are keenly interested in it."

That there is a widespread public curiosity about insanity is undeniable, but that any considerable section of the public—even the medical profession at large—are keenly interested in it we greatly distrust. Rather it would seem that, with the development of the asylum system, which condemns an ever-increasing number of imperfect minds to the seclusion of their own quarters, the contact of the public, and even of the profession, with the insane is continually diminishing, and rational interest degenerating into morbid curiosity which, irresponsive to systematic information, only relishes the stimulant of some sensational incident. In vain is the obvious platitude reiterated that, since the custom of social life and the law of the land place insane persons under the supervision of medical men, therefore candidates for medical diplomas ought to be examined as to their knowledge of mental diseases. In vain is it urged that a knowledge of lunatics is

of more importance to a doctor than that of plants, and that a study of psychological medicine will be of more value to him, and more useful to the public, than that of systematic botany; that a remote practitioner may never in his life meet with a single dislocation of the hip, but that he will be sure to encounter the unforeseen difficulties of dealing with some scores of madmen. The medical corporations refuse to add the burthen of so needless a study as that of insanity to their curricula, and the means and opportunities of such study for the profession at large have actually diminished; for whereas, in the time of our fathers, insane patients were met with in general hospitals, and one great London hospital at least devoted special wards to such patients, and the teachers and professors of medicine included mental diseases in their courses of lectures, the attendance upon which was compulsory, now all these opportunities for the instruction of the general medical student have been allowed to slide into disuse, and the clinical study of insanity is restricted to the dribbling admission of a few students into asylums by the grace and favour of the authorities, and the teaching to voluntary attendance upon psychological classes, most of which are skeletons, and some of them ghosts.

One great peculiarity of all Dr. Hack Tuke's writing is its precise conscientiousness. There is no author who less needs the disclaimer of dogmatism which we find in his eighty-eighth page. He is the most nice and precise of critics, and he tells us faithfully all that can be said on either side, or on all the sides, if the question is one upon which many facets can be cut. This is mostly a great merit, although it sometimes leaves the impression that he is trying, as the old song says, to "balance a straw." Another consequence of this thoroughness is that he cannot leave anything out, and therefore he commences his present work with a chapter on the "Causes of Insanity in Prehistoric Times." It may be assumed that the men of the drift period had no "books but the running brooks," which, however, are no records, and we are thus reduced to "the question of presumption and probability"—a question which perhaps we might approach by inquiring into the causes of insanity among existing savages. But informa-

tion, even upon this point, which we do not get, might be extremely misleading. The primeval ancestor of Mr. Tennyson, for instance, or of the late Bishop of Oxford—two gentlemen who have expressed great anxiety upon the point—was most likely a very different being either to the greater ape or to a native of New Guinea. Whatever he was, he contained within him the potentiality of becoming “the paragon of animals!” Surely there is no greater mistake than the widespread one that our anthropoid ancestors were like the stereotypes of monkey and of savage man which have come down to us through the æons as they now exist. At least they had within them this stupendous potentiality of development, to which, with capacity and promise of neural perfection, resulting from its very instability of definite form, the penalty of neural deviation into insanity may have been attached. This principle, that the tendency to involution under unfavourable circumstances goes *pari passu* with the tendency to evolution under favourable circumstances, explains many apparent anomalies; the propinquity of genius to madness, for instance, and the mental safety of the inert races of mankind compared with the ravages of mental disease among ourselves.

In his second chapter the author considers the causes of insanity among the Jews and the Egyptians, and in the third and fourth those among the Greeks and the Romans; and the various modes of living practised by these ancient folk are examined with much learning and discrimination, in order to lead to a probable answer to the question whether they were likely to have caused insanity. In the absence of all positive information as to the prevalence of insanity, these chapters come too much to resemble an academical exercitation to be of great scientific value. The Jews in Egypt may have been decimated by madness, or they may have been free from it. Who can tell? And as for guessing, can Dr. Tuke tell us how it was that a nation of slaves, born and bred under the most grinding bondage, acquired none of those qualities of mind which we know that in these days servitude infallibly impresses upon a race? How it was that a warrior race sprang from the flesh-pots and the brick-fields of the Nile? We

know nothing of Jewish madmen, save only of Saul, but we read much of their armies and their victories. How came these about, and what is the effect of slavery upon the mind? In his chapter upon the Greeks and Romans the author leaves this great component of ancient life unconsidered. And yet in Attica there were 400,000 slaves to 130,000 free-born natives and aliens. How small an effect must the classic influences which the author cites have had upon a population thus compounded? The result of the inquiry appears to be, that whereas the causes of insanity were pretty active among the ancients, the elimination of the unfittest was still more so; the duration of lunatic life was brief, and although many imperfect brains may have been begotten, few of them were reared.

Dr. Hack Tuke leaps over the middle ages, with their carnage and conventualism, their plagues and priestcraft, and it is pleasant to pass directly from the tepid zephyrs of classic learning into the crisp breezes of social science. Here there is so much motion from many points of the compass that we can no more than indicate the path of our author in the troubled seas of controversy. On the interesting question whether lunacy is on the increase in England, Dr. Tuke commences with the statement of that exceedingly stubborn fact that whereas twenty years ago there was one lunatic or idiot officially reported to 577 of the population, the latest returns place the ratio as high as one in 370. But he maintains that it remains an open question to what extent this vast disparity is accounted for by the prolongation of insane life and by the increase of population. The latter element might surely be computed with accuracy, and the former with considerable approach to the truth. The average duration of life in asylums is not an unknowable, scarcely an unknown, quantity, and any one possessed of statistical patience and power might surely give us a definite answer to this question, which has been written about in a vague and speculative manner quite long enough. "The apparent increase of insanity is mainly marked among those who become pauper patients;" but this fact "does not prove that there has been anything like a corresponding growth of insanity among the

poor as compared with the rich;" still, "no doubt, mental stagnation is in itself bad, but the insanity arising out of it is more frequently an indirect than a direct result."

The conclusion at which the author arrives, as to the insanity of the higher and lower classes of society, is expressed in the following well-balanced opinion:—

"Alternately swayed by the evidence which presents itself, now in the higher, now in the lower, ranks of society, of the fearful consequences of certain lines of conduct and living, alike ending in insanity, we seem at one time driven to the conclusion that a refined and over-civilised life, and at another that an unlettered one, most favours the spread of mental disorder. The right conclusion is, however, that both present their peculiar perils in different forms, but that the latter, in that form in which it displays itself in England, produces the largest amount."

The final conclusion arrived at on this point is, that, "looking not at the accumulation of lunatics in asylums, but at the admissions, and making every possible allowance for their considerable rise beyond that of the population, it is impossible to deny that there is reason to fear some real increase of occurring insanity."

The relation of insanity to drunkenness is left in the same questionable state. In the chapter on the lower classes drink would seem to be given as an explanation of the pauper predominance, while in the chapter on the higher classes it is recorded that at the Royal Edinburgh Asylum "there is even a higher percentage of insanity from this cause [drink] among the private than the pauper lunatics." It is a question of vast importance, which has been obscured by much exaggeration and misrepresentation, and which needs for its solution other methods and wider views than have yet been taken.

On the influence of intellectual work as a cause of insanity, the author does entertain a strong opinion. He indeed generally uses the term "mental strain," or "overwork," but this is somewhat begging the question. When intellectual work causes insanity, it may very justly be called overwork. But the amount of mental work which ought to be called overwork, and the circumstances in which it will be mischievous, are left in

the greatest uncertainty. That weak brains are injured by work which is only fit for strong ones, and young brains by that which is alone adapted for older ones, may well be believed by any one without the aid of that beautiful essay on the Building of a Brain, by Dr. Robert Clarke, of Boston. It is difficult to find any limit to the work which sound and sane brains may do without injury, but it is also hard to conceive the minimum of work which may safely be encountered by poor, weak, and twisted organisms, with inherited propensities to break down, aided by unwholesome modes of life, and exacerbated by emotional disturbances, by the anxiety and worry, the emulation and envy, of the competitive-examination system. Examine boys, and girls too, by all means, to ascertain that they are not idling time away, nor taking wrong and devious paths of thought; but to urge brains of tender age into racing pace with each other by the whip and spur of keen emulation, is a mode of modern life which is righteously denounced by the author.

"Mental strain in modern life is not only in some cases a cause of insanity, but it very frequently induces general exhaustion, or disease of the heart or some other organ than the brain. If, therefore, lunacy statistics do not supply us with the figures which would enable us to point to the occurrence of insanity as the result of undue intellectual work on so large a scale as might be expected, there can be no doubt the penalty is often paid in other forms."

"Too many hours' daily study and the knowledge of an approaching examination, when the system is developing and requiring an abundance of good air and exercise, easily account for pale and worn looks, frequent headaches, disturbed sleep, night-mare, and nervous fears. When the career of such students does not end in graduating in a lunatic asylum, they lose for years, possibly always, the elasticity and buoyancy of spirits essential to robust mental health."

Yet we doubt that the evil is widespread, or that the youth of England are as a rule overtaught. In our public schools athletics are supreme and learning subordinate, and if those noble peers who recently raised a discussion in the House of Lords on the physical deterioration which scientific teaching

is causing among the officers of our army, had taken the trouble to read the *Field* newspaper, they might well have been surprised to discover the exalted position held by our Engineer officers in the records of the sturdy game of football—the game of all others wherein muscle, wind, and pluck are taxed to the utmost, and in which these puny and enervated students have fought their way through all the football clubs in the kingdom to the very highest places.

The truth seems to be that only the weakest go to the wall, and that with mental overstrain, as with intemperance and other unquestionable causes of insanity, we must look to the circumstances and complications under which the cause acts, for its efficiency. The seed only germinates in prepared ground, "many factors go to make up the sum total of causes of an attack," and "where the constitution has no latent tendency to insanity, you may do almost what you like with it, in this or any other way, without causing this particular disease."

The third part of the work is entitled "Auto-prophylaxis, or Self-Prevention of [from] Insanity." The author does not believe that we are "conscious automata," but that "we can exert our will over our mental processes to a very large extent," and that "in no instance is it more important that men should recognise their own will, and the obligation of employing it to control those really automatic tendencies of the mind which often are strikingly characteristic of insanity." This poor will of ours has much to endure and much to do. Not only, like the domestic cat, does it break all the crockery, but it has to mend it again. "The essence of insanity is a diseased will," writes a recent author, and now we are told that the prevention of insanity lies in the employment of a sane will. For ourselves, we always feel that when the will is brought forward in argument, there is nothing more to be said, and in a double sense we admit the truth of the old proverb, "A wilful man maun ha' his way."

The ninth chapter, on "Warnings of Danger," pleases us the best, being most practical and positive. The warning voice may be listened to, not by the patient alone, who is often deaf, but by those to whom his sanity is as precious as to him-

self; and if the prodromata of mental disease could only be recognised, and the morbid causes and processes resisted, there might be the sure expectation that the annual crop of insanity would be greatly thinned.

The most formidable danger-signal—the drum at the mast-head—is inability to sleep. The foe, shunning the garish eye of day, loves to assail us in the dark, when spectres of the mind “perplex us, worry us, scare us, render us restless and utterly unable to regain our broken sleep.” The man whose brain is overwrought—“if he neglect this one symptom—sleeplessness—he is running a great risk of losing control over his mental operations and becoming unable to apply his mind to his duties, the facile descent to actual madness being the sequel.”

The author explains the production of morbid wakefulness by “the sympathetic nerves controlling the calibre of the arteries, and the capillaries in the brain lose their grasp upon the vessels, and their powerful antagonist—the grey matter of the brain—persists in keeping up its molecular activity; an activity which may be of a productive description, leading for a time to brilliant results, but more often imperfect and intermittent; and ending at last in vague, irregular, and indefinite mental action.”

How it is that the sympathetic nerves come to lose their controlling power on the brain capillaries in the early stages of insanity, is another question to which no answer is suggested, so that the cause of morbid sleeplessness is only put back a stage, if this theory of its immediate production be correct.

Another danger-signal—say, the cone half-mast high—is inability to do the same amount of mental work as before. Yet another is strange unfounded fear about the future; and another indecision of mind not natural to the character.

When these warnings of danger are observed, the author gives the following excellent advice, which if it were followed would no doubt be most efficacious; but which we fear will almost always amount in practice to the advice given to a drowning man to get out of the water. “Let him whose judgment is so bewildered by opposing forces and rival claims, and whose action is paralysed in consequence, promptly and

resolutely determine upon one or other course, either on his own or another's judgment, and exercising all his self-control stick to it without faltering or wavering. If not, he will only plunge deeper and deeper into the mire, which will render him more and more unable to move forward and employ the faculties he possesses to any purpose." The author takes as text for his chapter on the preservation of sanity by means of cheerfulness and mental rest, the wise couplet which, he says, has been taught to us by the school of Salerno :—

"Si tibi deficiant medici, medici tibi fiant
Hæc tria; mens hilaris, requies, moderata diæta."

It was, in fact, John of Milan, one of the Salernian doctors who wrote these wise and pretty lines in his Aphorisms, not concerning the prevention of insanity, but the prolongation of life; and here is another of his precepts yet more applicable to the former object :—

"Fi vis incolumem, si vis te reddere sanum,
Curas tolle graves, irasci crede profanum;
Parce mero; cœnato parum; non sit tibi vanum,
Surgere post epulas."

Limits of space forbid us from wandering further in our remarks upon the author's varied pages. Also we cannot quite dismiss the fear that when author or critic writes with prolixity he may be set down as trying to prevent his own insanity by the exercise of that literary composition which the author recommends as a sovereign remedy for certain mental disorders. But madmen themselves can write profusely, and not badly either, as that interesting though imperfect record, 'La Littérature de Fous,' sufficiently testifies, while writings about them are fast becoming a literature all too vast for comprehension, of which, however, this last contribution of Dr. Hack Tuke's, not ponderously scientific, will form a pleasant interlude.

JOHN CHARLES BUCKNILL.

Relazione Statistica Clinica del Frenocomio di S. Margherita di Perugia per gli anni 1874, 1875, 1876. Medico Direttore
ROBERTO ADRIANI.

THE Report of Dr. Robert Adriani, Superintendent of the Asylum at Perugia, gives the statistics of three years, with the results of his experience, and the most remarkable cases during this period. It is evident that Dr. Adriani has the current questions on physiology, pathology, and medicine ever present in his mind, and is a diligent reader of the principal French, German, and English writers who deal with insanity and the diseases of the nervous system. The result is an interesting and valuable report in a quarto pamphlet of 105 pages, one half of which is filled with statistical tables. In framing these tables he has used the classification of Verger which was adopted at the Psychological Congress at Imola. It has the following divisions: Imbecility and Idiocy, Mania, Monomania, Melancholia and Dementia, Moral Insanity, Circular Insanity, Sensorial or Delusional Insanity (Frenose Sensoria), Hypochondriacal Insanity, Hysterical, Puerperal, Epileptic, Alcoholic and Pellagrous Insanity, General Paralysis.

Dr. Adriani's statistics are very favourable. Out of 286 admissions he had 123 cured, and 16 improved, that is to say, 44 per cent. of cured; subtracting 42 idiots and incurable demented sent from other asylums, the proportion of cures was one half of the admissions. A hereditary tendency was found in 161 patients out of 472. Among the curious and instructive cases described by Dr. Adriani the following seem most worthy of record.

He cites the experiment of Charles Sachs, who isolated a muscle in a frog, leaving it only connected with the nerve which entered it, and then applied electricity both to the nerve and the muscle. In either case there was a reflex general convulsion. He then applied ammonia to the muscle, so far diluted that it would act upon the muscle and not upon the nerve. He again obtained a general reflex movement of the animal, which he concluded to be the result of the pressure exercised upon the nerve fibres distributed through

the muscle. Both Sachs and Remak found a delicate network of nerve fibres encircling or lying upon the sarcolemma, and it is supposed that these are centripetal nerves which communicate to the brain the sensation of accomplished contraction.

Dr. Adriani gives a case which he thinks confirms this view. A man of forty-eight entered the asylum with melancholia and religious delusions. After some days he fell into an insensible condition, the limbs motionless and relaxed; the pulse, respiration, and temperature were normal. It was found impossible to rouse him; irritation of the eye or nostrils produced no effect; and neither cold nor heat applied to the body caused any movement.

Electricity with dry conductors was applied to the most sensitive parts of the skin, and acupuncture and shampooing were also used without effect. It was then determined to test the electro-muscular contractility, and by means of wet conductors the induced current was transmitted to the gemellus internus of the leg. The muscle immediately contracted, and the contraction was followed by a general start of the whole body. The patient recovered as if by enchantment; he saw, heard, moved himself, spoke, and answered questions. He complained of weight in the head, and had a great desire of going to sleep.

Dr. Adriani argues that the man was roused by the sensation of the muscular contraction caused by the application of electricity to the muscles of the leg.

The causes of insanity found in the asylum at Perugia which are not met with in this country, are pellagra and miasmatic fever. The pellagrous form is noted as giving a bad prognosis. All the cases traced to miasmatic infection came from the Agro Romano, the neighbourhood of Lake Thrasimene, and other localities known to be the haunts of malaria. In most instances the insanity seemed to result from secondary oligæmia; but some had suffered from the pernicious comatose form of miasmatic fever, in which the oligæmia was connected with venous congestion and splenic and hepatic hypertrophy, and with a dusty colour of the skin. He conjectures that the continual mechanical irritation of the pigmentary matter in

the walls of the vessels or in the parenchymatous substances of the cortex cerebri had disturbed the nutrition and excitability of the nerve cells, or that, through deposit of the pigment, embolisms had been produced, causing anæmia and partial atrophy of the cerebral substance. In these last cases the insanity took the form of melancholy with hypochondriac delirium, ending in dementia.

Dr. Adriani had a patient, a girl of seventeen, of imperfect intelligence, with predisposition to insanity inherited both from father and mother. Being frightened at the sight of a conflagration, she was seized with melancholy, hypochondriac delirium, refusal of food and persistent stupor. She had to be fed with the stomach pump. During six months of her residence in the asylum she made no progress, when she was seized with typhoid fever of the usual type. During the first seven days of the malady she appeared more lively than she was before, which was attributed to the more rapid irruption of blood into the brain, increasing the activity of the organ; and, with the progress of the fever, her intelligence, instead of becoming weaker, became clearer and more open. When convalescence commenced, the dislike for food completely ceased, the affections revived, and all traces of stupor and delirium disappeared. For a time there still remained some mental abnormality, which took the form of heightened imagination and an exaggerated idea of her own importance; but after some days the cure became complete. Before the subvention of the insanity, her intelligence was weak and imperfect and her affections obtuse, but they now took a new and unaccustomed growth, which has gone on for two years.

Dr. Adriani cites a number of cases where recovery from insanity supervened upon typhoid fever; the most remarkable was an idiot of eighteen years of age, who had never uttered any word save "mamma," but after an attack of typhoid fever, from being of a sad disposition he became gay, and he learned to express his ideas with various words, to sing songs, and to keep in mind the names of things and persons.

In those who died in the asylum of pellagra, the cerebral lesions were various, as in ordinary dementia. The most common were paleness, cedema, and often also atrophy of the

cortical surface, fatty degeneration and greater fragility of the vessels, and serous and bloody effusion under the arachnoid.

In one of his dissections, Dr. Adriani found the corpus callosum deficient. The subject was a man of thirty-eight years of age, a shoemaker by trade. He had been an epileptic for twenty years, and insane for seven years. His grandfather had been demented, and he himself was given to drunken habits. His insanity at first took the form of mania, with hallucinations of hearing and touch, and then subsided into a restless dementia. He died of the consequences of the epilepsy. Before being seized with this disorder, the man could neither be called idiotic nor imbecile, though his intelligence was not good.

Not only the corpus callosum, but also the septum lucidum and the middle and anterior part of the fornix, were found wanting. There was also a general softening of the brain, with œdema and paleness of the cortical substance, effusion of blood under the arachnoid, and inflammation of the middle part of the superior longitudinal sinus.

Dr. Adriani tells us that science possesses twenty-one other instances of want of the corpus callosum, and that four of these were troubled with epilepsy. In many of them, however, other parts of the brain were wanting; where the corpus callosum alone was deficient, as in the cases of Sander and Malinverni, the intelligence was not found to be deficient.

The author has tried arsenic in cases of intermittent insanity, hallucinations, and chronic cerebral congestion. He used it in 89 patients: 20 of these had pellagrous insanity; 7 intermittent mania or melancholia; 9 delusional insanity; 12 general paralysis or congestive insanity (*folia congestiva*); and 41 various forms of mental alienation connected with anæmia, deficient nutrition, and wasting of the body. Arsenious acid was given, after the formula of Boudin, along with the food, diluted with water and mixed with wine, in a gradually increasing dose of from 2 to 15 milligrammes in the day. Interruptions were now and then made in the administration of the drug. It was generally well tolerated. Of the twenty pellagrous patients thirteen gained great benefit; the others none at all. These last were in a more advanced state of pellagrism. In general those cases derived the most benefit

who were in an anæmic and ill-nourished state. Dr. Adriani believes that no medicine has such power of restoring impoverished nutrition. In many cases, within a week the patients recovered flesh and colour, after iron and other remedies had been found to fail. It ought to be remembered that this was in a southern climate, where diseased conditions are liable to be profoundly modified by paludal malaria. Of the forty-one patients treated with arsenic sixteen were cured. In seven cases of intermittent mania only one derived benefit. The medicine also gave some encouraging results in congestion following upon alcoholic excesses.

WILLIAM W. IRELAND.

School Life in its Influence on Sight and Figure. Two Lectures by R. Liebreich, Consulting Ophthalmic Surgeon to St. Thomas's Hospital. London: J. and A. Churchill, 1878, pp. 36.

IN this admirable pamphlet, which ought to be in the hands of every teacher, architect, and upholsterer, and from which the reading public generally may derive some useful hints, Dr. Liebreich shows that errors in the distribution of light in schools and houses, and in the posture habitually assumed during study, may interfere with the range, acuteness, or endurance of vision, and deform the figure, and so damage health. With reference to myopia, which is increasing in frequency in England as in all civilised countries, he asserts that it is to a great extent caused by the circumstances of school life, and that the percentage of short-sighted children is always greater in schools where unfavourable optical conditions prevail. Amblyopia and astheniopia are also, he thinks, often caused by unsuitable arrangements for work. The observance of a few simple rules which seem hitherto to have been strangely overlooked, and which the Committee of Council on Education in their directions for the planning and fitting-up of schools utterly disregards, will, he believes, obviate the serious evils which he has traced to their source. Light must be admitted from the left hand and from above, and must be sufficiently

strong. Ground and ribbed glass must be used but sparingly and with discretion. Gas jets must be shielded by glass cylinders and reflectors. Every one when reading and writing must sit straight, and have a support to the back. The book or paper must be distant at least 10 inches from the eyes, and must be raised to an angle of 40° for reading and 20° for writing.

A lateral curvature of the spine, dependent upon a twisting of the vertebral column round a vertical axis and accompanied by depression and prominence of the right shoulder, projection of the lower ribs on the right side, with complementary deviations on the left side and obliquity of the pelvis, which is of exceedingly common occurrence, has its principal origin, according to Dr. Liebreich, in the position in which children are made to sit during school-time, and especially while writing. The anatomical process by which this affection is developed is said to consist in stretching of the ligaments which connect the vertebræ, in a breaking-down of the osseous elements in the middle of the spongy texture of the bodies of those vertebræ upon which the ill-adjusted weight chiefly falls, and in atrophic changes in the over-extended muscles on the convex side of the vertebral column. With much ingenuity Dr. Liebreich differentiates three varieties of curvature corresponding with three different attitudes habitually assumed during writing.

We have no doubt of the correctness of Dr. Liebreich's observations, nor of his conclusions as to the prevalence, physiological explanation, and best methods of preventing the deviation from normal figure, which he has described in so clear and interesting a manner; but we question whether he is justified in ascribing this deviation exclusively to unfavourable conditions of school-life. The special unfavourable conditions denounced may be responsible for many and wide-spread evils, but we hesitate to believe that they will of themselves cause spinal curvature; and that a robust child will become permanently deformed by sitting slightly awry for a few hours daily. When the unfavourable conditions referred to do work mischief, they are probably acting in combination with constitutional delicacy, with vis-

cereal disease, or with other vicious habits of life. That this is so is evidenced by the facts that scoliosis is more frequent in children of the higher than in those of the lower classes of society, in town than in country children, and in girls than in boys. We lately examined upwards of one hundred children, of both sexes, in a rural district of Scotland, attending two schools, in which all the adverse circumstances pointed out by Dr. Liebreich existed in a marked degree. The windows were on both sides, and in one end of the school-rooms the benches were mostly without backs; there was a considerable distance between the seats and desks, so that the children had to sit on the edge of the former and lean forward when writing; and the desks were disproportionately high. In not one of these children could we detect scoliosis. The figures of all of them were not, of course, strictly symmetrical; but no deviation from the normal standard which could be dignified by the name of a deformity was discovered. They were straight, sturdy, active children. But they came of a hardy stock, lived on a frugal but wholesome dietary, in which oatmeal bulked largely, spent much time in the open air and in out-door work and games, and walked on an average three miles a day to and from school. It is in the absence of such healthful modes of living out of school, or in the presence of degeneration, that scoliosis shows itself, and that the precautionary measures indicated in the pamphlet before us become necessary. We do not mean to extenuate negligence as to the maintenance of a proper posture during educational drill, nor to justify a disregard of anatomy in the manufacture of school-furniture; but what we wish to insist on is, that errors of bearing in school hours are almost innocuous unless they co-operate with other morbid or deforming agencies, and that these latter may be to a great extent compensated by plenty of freedom, exercise, and play out of school hours. More important than the shape of the desk and bench is the quantity of desk and bench to which young children are subjected. When that is not excessive, nature will do much to avert scoliosis, and to preserve a useful symmetry of figure. The feelings of a child that is not diseased or grievously over-taxed in strength may be trusted to do much for bodily equilibrium, and to make up for prolonged strain

by prolonged relaxation. Sleep, too, will do something to readjust the balance; for it has always seemed to us that the decubitus at night has a reference to the prevailing posture by day, and that sleep not only

“Knits up the ravell’d sleeve of care,”

but undoes muscular knots and smoothes out osseous twists. But in order that it may accomplish this, sleep must have fair play, and the disposition of the body and limbs must be determined by the sense of fatigue, and not by mechanical, thermal, or other considerations. Dr. Liebreich would be doing a public service if he would extend his criticisms on school-furniture to school-dormitories, and would impress on those who are responsible for their arrangements the importance of providing commodious, comfortable beds, and a sufficiency of bed-clothes, and of regulating their temperature with a regard to seasonal changes and the physical condition of their occupants, so that children may not have to huddle themselves together, to roll themselves up like hedgehogs, or to put their heads under the bolster in the pursuit of warmth.

Dr. Liebreich concludes his second lecture by a sketch of the ugly disfigurement produced by a fashionable stay-maker, who has a great reputation for curing scoliosis. Could her aristocratic victims but see themselves as the anatomist sees them, they would never “court an amorous looking-glass” again.

J. CRICHTON-BROWNE.

Dr. Féré on Cerebral Topography. Note sur quelques points de la Topographie du Cerveau. Mémoires de la Société de Biologie de Paris. 2me Série, t. iii. Fascic. 3, p. 91.

It was Gratiolet who, in 1857, was first to conceive the idea of discovering the relations of the sulci of the brain to the overlying sutures of the cranium. He made moulds in plaster of Paris of the cranial cavity, but the depressions and projections of the internal surface of the skull do not suffice to give an exact idea of the form and relations of the cerebral convo-

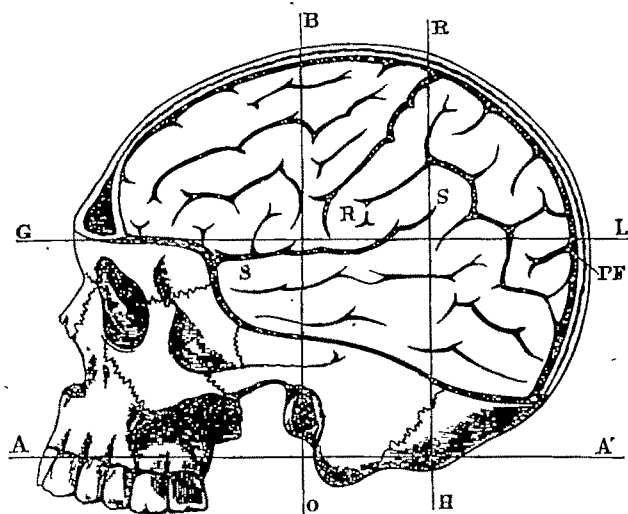
lutions, and he was accordingly led to believe that the fissure of Rolando was parallel and subjacent to the coronal suture. In 1861 M. Broca embarked upon fresh researches with a totally different method, viz., by drilling holes at the exact position of the points of intersection of the various sutures of the cranial vault—at the *bregma*, the apex of the *lambda*, and at the external extremity of the coronal suture. Through these holes he introduced pegs into the subjacent cerebral substance, and was thus enabled to witness the fact, by the examination of eleven subjects, that the fissure of Rolando lies much posterior to the suture in question. In 1874, M. Heftler presented to the Medico-chirurgical Academy of St. Petersburg a thesis on this subject. His procedure, which was carried out on ten subjects, though quite novel, was somewhat complicated, consisting as it did of taking casts of the scalp and cranium successively, and afterwards projecting a sketch of the convolutions upon a drawing of the casts. M. Heftler, though ignorant of M. Broca's researches, came to conclusions in accordance with those arrived at by the French professor; but it is to be regretted that the former has not given any guide whereby we may recognise upon the living body the salient points which he has been led to define. M. Féré, a pupil of Prof. Broca, particularly with a view to the localisation of surgical lesions of the brain, has made a number of observations upon persons of both sexes, viz., upon fifty-four females, mostly above sixty years of age, at Salpêtrière, and at Bicêtre, upon forty men of about the same age.

The fissure of Rolando, as M. Broca has already pointed out, is far from approaching so near to the anterior extremity of the brain as is generally received. If a brain be examined after removal from the skull, the convexity of the hemispheres will be seen to tend to become plane again, especially at their posterior part, though this region has a very pronounced curvature, when the brain is lying *in situ*, in the cranial cavity; and the fissure of Rolando would accordingly seem to be advanced to a proportionate degree as the brain is more prolonged and flattened out. In order then to determine its exact position the brain must be measured *in situ*, the head being kept raised as much as possible. It is better, too, to

leave the *dura mater* intact, only incising it just sufficiently to lay bare the fissure, so as to preserve, as much as possible, the shape of the brain; but such results cannot be properly attained, until after the head has been frozen. In old subjects the sutures are often obliterated, but they can be made visible again by moistening the denuded bone with some colouring matter, such as ink, which readily penetrates into any interstices. The external perpendicular fissure has pretty constant relations with the summit of the occipital angle, for thirty-nine times out of sixty-two it corresponded accurately with it. Further down is the occipital lobe, which descends as far as the external occipital tuberosity, while in front are the quadrilateral lobule and the supero-parietal. The perpendicular fissure lies on the same horizontal plane as the anterior extremity of the brain. The fissure of Rolando is far from being parallel and subjacent to the coronal suture, as Gratiolet thought. In the female its posterior extremity is, on an average, forty-five millimètres behind the *bregma*; this distance being a little longer in men, measuring about forty-seven or forty-eight millimètres, according to the observations of M. Broca and the author of this paper. This fissure, though much more oblique than the coronal suture, tends to approach the latter at its lower extremity, but terminates at least one centimètre higher than the suture, as it never descends as far as the fissure of Sylvius.¹ The external extremity of the coronal suture corresponds to the interval of the two folds of the third frontal convolution. From the situation of the fissure of Rolando it can be deduced that the anterior ascending parietal convolution [ascending frontal] and the posterior part of the frontal convolution lie behind the coronal suture. All the parts, then, lying between the fissure of Rolando and the perpendicular fissure are covered by the parietal bone. All these parts, or nearly all the parietal region of the cerebral surface, derive their blood supply from the Sylvian artery and

¹ M. Féré's statement should be qualified. Prof. Turner says ('Convolutions of the Human Cerebrum Topographically Considered,' p. 10, Edin. 1866), that he has "more than once seen the fissure of Rolando prolonged so far downwards as to be continuous with that of Sylvius." Prof. Macalister, too, records a similar case (*Proc. Dublin Univ. Biol. Ass.*, vol. i. No. 2, p. 25).

its branches, according to the observations of M. Duret. In order to determine the posterior extremity of the fissure of Rolando R., which lies at an almost constant distance behind the *bregma*, it suffices to fix the situation of the latter. This lies on the vertex of the skull where this is cut by the upper end of a normal, O B, drawn perpendicularly to the line called by craniologists "alvéolo-condylien" A A', and passing through the middle of the external auditory meatus—the "auriculo-bregmatic" line of Busk.¹ If a line R H be drawn parallel



to the latter from the upper (or posterior) extremity of the fissure of Rolando this will almost exactly cut the *asterion*, or point of junction of the occipital, temporal, and parietal lobes.² This line will also indicate the posterior limit of the Island of Reil. A little behind lies the posterior [superior] extremity of the fissure of Sylvius S S and the "Pli courbe." The perpendicular fissure P F answers in most cases to the *lambda*; and here there is, in the majority of skulls, a characteristic angular

¹ According, however, to Dr. Topinard, in his 'L'Anthropologie,' p. 252, Paris, 1876, the *bregma* is the spot where the coronal suture reaches the middle line of the cranium.

² The *asterion* is thus defined by Dr. Topinard, *Ibid.*: "point de rencontre, en arrière l'apophyse mastoïde, des trois os pariétal, occipital et temporal."

projection. This fissure may also be indicated by the posterior extremity of a line G L passing from the *glabella* to the occiput, and running parallel to the "alvéolo-condylien" datum line.¹

M. Féré makes no allusion whatever to the valuable researches made by Professor Turner in the same direction, the results of which were published in the *Journal of Anatomy and Physiology*, Nov. 1873 and May 1874 (vols. xiii. and xiv.), and have been later fully referred to at the end of the last chapter of Professor Ferrier's 'Functions of the Brain,' Lond. 1876.

JOHN C. GALTON.

Nervous Diseases, their Description and Treatment. By ALLAN M'LANE HAMILTON, M.D. London: J. & C. Churchill, 1878, pp. 504.

DR. M'LANE HAMILTON may be congratulated on having produced a concise and practical book on nervous diseases, and on having thus achieved the object which he prescribed to himself on commencing the laborious literary task, the fruits of which now lie before us in a large, well-arranged and well-printed volume. This is unquestionably the best and most complete text-book of nervous diseases that has yet appeared, and were international jealousy in scientific affairs at all possible, we might be excused for a feeling of chagrin that it should be of American parentage. A glance at its pages shows that the greater bulk of the material of which it is composed has been derived from English sources, and it might naturally have been anticipated that the digestion and compilation of that material would be accomplished in England. This work, however, has been performed in New York, and has been so well performed that no room is left for anything but commendation. With great skill Dr. Hamilton has presented to his readers a succinct and lucid survey of all that is known of the pathology of the nervous system, viewed in the light of the most recent researches. In so compre-

¹ The woodcut is copied from Fig. 2 of the plate which accompanies M. Féré's paper.

hensive an undertaking, involving such a number of moot questions, it is of course inevitable that criticism should be challenged on many pages. Frequently we find ourselves differing from Dr. Hamilton's conclusions and recommendations; but to discuss the points of divergence would be to enter upon details, and to leave untouched the general scope of the volume. From the preliminary description of the methods of examination and study, and of the instruments of precision employed in the investigation of nervous diseases, up till the final collection of formulæ, the book is eminently practical. It brings together much scattered information in a methodical and well-balanced manner. We think, however, that it would enhance its usefulness if, in future editions, Dr. Hamilton would give more prominence than he has now done to the psychical symptoms of nervous diseases; if he would supply specific indications for treatment, and fuller directions for the employment of his formulæ, in the manner of Tanner's 'Practice of Medicine'; and if he would amend his pictorial illustrations, which as they now stand are the weakest part of his work, having neither artistic nor diagrammatic merit.

J. CRICHTON-BROWNE.

Clinical Cases.

THE BRAIN IN CONGENITAL ABSENCE OF ONE HAND.¹

BY W. R. GOWERS, M.D.,

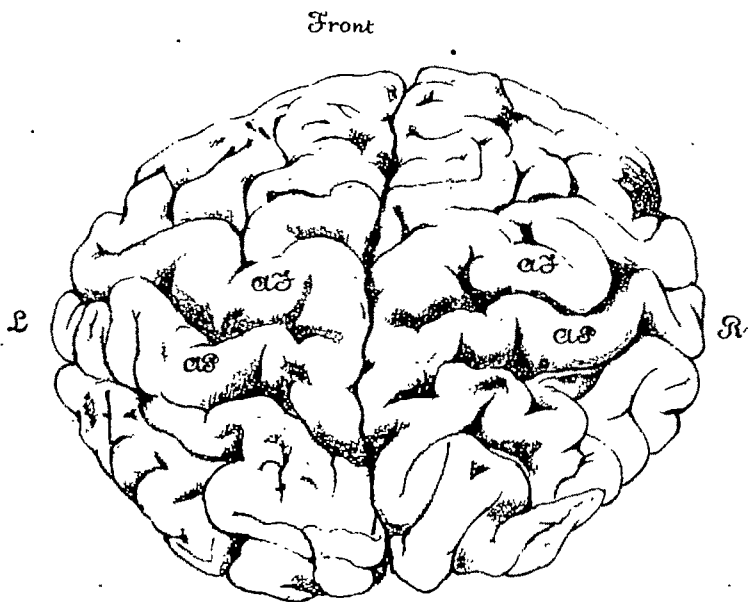
Assistant Professor of Clinical Medicine in University College.

THE correlation of experimental and pathological facts of the localisation of function in the brain is at present far from complete. The following case is interesting as presenting a very close correspondence between the cerebral locality affected in a case of congenital defect of the hand, and the region of the brain to which, according to experiment, movements of the hand seem to be specially related.

The brain, a photograph of which is represented in the accompanying figure, is that of a man, aged forty, whose left hand was absent from birth. He died in University College Hospital from general paralysis.

A careful dissection of the arm was made by Mr. V. Horsley, who found that the forearm bones were normally developed and that at their extremity there was only an irregular mass of bone apparently consisting of the two rows of carpal bones very imperfectly developed and ankylosed together except at one point. The radial third of this mass was capable of a slight rotation around the long axis of the remaining two thirds. Both pieces were connected by strong ligaments and the surface was irregularly nodulated. Over this surface was a fibrous capsule into which both the muscles of the forearm were inserted, and which was movable upon the bones. All the muscles of the wrist and hand were present except the extensor minimi digiti. All were inserted into the capsule over the carpus with the exception of the following. The

¹ Read before the Royal Medical and Chirurgical Society of London.



Frontal and Parietal lobes of a brain in a case of congenital absence of the left hand viewed from behind. *AF. AF.* ascending Frontal convolutions. *AP. AP.* ascending Parietal convolutions. The two latter are seen to present a marked disparity in size in their middle thirds, outside the letters.

From a Photograph.

flexor carpi radialis was inserted partly by a slip to the capsule and partly by another into a nodule on the radial side of the anterior surface of the malformed "carpus." The flexor carpi ulnaris was inserted into a similar nodule on the ulnar side. The extensor indicis was inserted partly by a slip into the radial part of the capsule at its posterior border, and by another slip into the ulnar side of the posterior "carpal" surface.

The nerves and veins of the forearm were normal. The arteries were normal, with the exception that they did not anastomose at the wrist.

The two hemispheres of the brain were nearly of the same size. On comparing the individual lobes and convolutions of the two sides, with one exception, little difference was apparent. The frontal convolutions were nearly of the same area: on the right side they were individually somewhat smaller, but more complex in arrangement, and from a careful comparison of the two sides it seemed probable that there was little difference. The ascending frontal convolutions were quite equal. Between the two ascending parietal convolutions a marked difference existed. At their origin at the longitudinal fissure, for the first inch of their extent, they were nearly equal in size,¹ and continued nearly equal for the upper inch and a half. In the next (middle) two inches there was a very marked difference, the right being a narrow single convolution and the left broad and depressed by a slight secondary sulcus. The measurements of a transverse section of the two convolutions just outside the spot at which the letters are placed were—the right .35 inch, and the left .65 inch. The lowest extremities of the two convolutions were equal in size. No disparity in size between the convolutions of the rest of the parietal or occipital lobes could be detected.

A careful examination of the central ganglia of the brain showed no disparity in size.

A microscopical examination of the two ascending parietal convolutions showed very little difference in their structure. The grey layer was of equal depth and presented layers of nerve cells of the same thickness, and in which the cells of each kind, small and large, were equally numerous and conspicuous on each side.

REMARKS.—The chief interest of the case arises from the fact that the diminution of size of the ascending parietal convolu-

¹ In the figure the upper extremity of the left convolution appears larger than the right, but this is in consequence of their connection with the convolutions of the superior parietal lobules.

tion on the opposite side of the brain occupies precisely the area, stimulation of which, according to the experiments of Ferrier, upon monkeys, causes movements of the opposite hand. I am not aware that the brain has been examined in any similar case. In several instances, in cases of old amputations of the arm, an atrophy has been found, but it has been slight, and has not been uniformly localised. The strict limitation of the atrophy to the hand-region in this case affords striking support to the experimental results. The fact that the structure of the two convolutions did not differ, may be associated with the circumstance that the forearm muscles for the hand were present, although they could not have been used; or it may be due to the fact that the representation of parts in the brain is nowhere exclusive, but only preponderant.

TWO CASES OF MICROCEPHALIC IDIOTCY IN ONE FAMILY—CONVULSIONS OF MOTHER DURING PREGNANCY.

BY HERBERT R. O. SANKEY, M.B. LOND.,

*Assistant Medical Officer to the Warwick County Lunatic Asylum, late Resident
Medical Officer to the National Hospital for the Paralyssed and Epileptic.*

By the kindness of Dr. Parsey, I am permitted to describe the two following cases of microcephalic idiotcy at present under his care. I am aware that, without post-mortem examination, a description of these cases must of necessity be very imperfect. Since, however, many years may not improbably elapse before such an examination could be made, I venture to publish the following clinical record, in the hope that it may be found to contain some points of interest.

Anne G., æt. 19 years, and Emily G., æt. 11 years, two sisters, were admitted into the Warwick County Lunatic Asylum in the years 1870 and 1872 respectively.

The family history, the greater part of which was obtained from their mother, is as follows:—

The patients' paternal grandparents were first cousins. Their father, who is a shoemaker by trade, also married his cousin. He is described as a sickly-looking man, of a nervous temperament, and is said not to be possessed of the average degree of intelligence. The mother also is a woman of no great mental activity. Neither parent has any insane relations; the youngest child, however, is, in all probability, like the two patients, a microcephalic idiot, but no other members of the family are idiotic; there is, however, a strongly marked family tendency to hysteria and nervous irritability generally. The mother suffered from fits during certain of her pregnancies, and, as will be seen from the following account, her convulsions bear an interesting relation to the idiotcy of her children.

During her first pregnancy Mrs. G. had one slight fit.

The child, however, though strumous, has not grown up an idiot. While pregnant with her second child, the elder of the two patients, their mother suffered from severe epileptiform convulsions. The third pregnancy gave rise to a healthy child, and was not accompanied by fits, but during the gestation of Emily, the younger of the two patients, and the fourth child of the family, Mrs. G. again had fits. Two miscarriages then succeeded, and then four children were born, who, though weakly, were not idiotic, no convulsions occurring during these pregnancies. During the gestation of the youngest child, however, now only two years old, the mother again suffered from epileptiform seizures. Though this child has not been examined, there is good reason to suppose that it is an idiot, since its mother says that it has a small head, and that it does not take notice, nor attempt to speak. Like others of the family it is physically a weakly child, and suffers from enlarged glands about the neck, &c. Nevertheless the mother seems positive that this child is more than ordinarily backward in the development of its mental faculties.

The parents are temperate people, they live in a small country town, and have always had sufficient food and clothing.

The father's brother died of phthisis, but no other members of the family are known to have suffered from that disease.

The elder sister, Anne G., now 19 years of age, has always enjoyed good bodily health, though she has been an idiot from birth. She has never suffered from fits, nor had any serious illness. When admitted into the asylum she was 11 years of age. Her stature was at that time not below the average. Her limbs were well proportioned. Her head was remarkably small, but its dimensions were not recorded. All the cranial sutures were closed. Her mental condition appears at that time to have been very similar to its present state. Her general health was good. She ate well, but was not able to feed herself. She was dirty in her habits, and passed her dejections without regard to time and place. Though spiteful at times, her temper was then pretty good. She is described as lively, and was pleased at being noticed.

With advancing years she became more irritable and morose in her temper. During the three years subsequent to her admission she grew a little, but since the expiration of that time little or no growth has taken place. In 1873 her head measured 14 in. in circumference.

During the next three years there seems to have been some slight advance in her mental condition. She learned to use articulate sounds, but not to speak intelligibly. She became however more spiteful and passionate. In her bodily con-

dition there was no great change, except that in 1876 the catamenia became established.

At the present time her height is 3 ft. 10½ in.; from her habit of stooping, however, she looks much shorter. She is rather stout, and weighs 63 lbs. She is still dirty in her habits, and allows her saliva to run from her mouth. Her most striking feature is her small head. Her forehead slants backward, so much as to be nearly in a straight line with her very prominent nose. Her incisor teeth project considerably, her chin is small, and the cheek bones are high and wide—a combination of features which makes her expression resemble that of a beaver, or water rat. Her occiput is so small that it scarcely at all overhangs her neck posteriorly. The cranial sutures are all closed, and there are no inequalities to indicate their position, so that the share taken by each bone in the formation of the skull cannot be determined.

The occipital protuberance is not well marked. The occipital bone appears at first sight as if it were tilted forward, so that the protuberance is raised to a point higher than normal. Below the most prominent part (Fig. I.) there is a depression about an inch in length, and half an inch wide, and a quarter in depth. But at this point the bone feels subcutaneous, and no ridge can be felt, nor can any ligamentous band be distinguished, even on flexing the head to the utmost, extending to the protuberance from the spines of the vertebræ. The following are the chief measurements of the head:—

Greatest circumference	14½ in.
Greatest antero-posterior diameter	4½ "
Distance from one auditory meatus over the vertex to the other	9 "
Longest transverse diameter	3½ "
Distance from root of nose to most prominent point at occiput	7½ "
Transverse diameter at mastoid processes	3½ "
Distance from auditory meatus to middle of brow	3½ "
Do. do. to prominent point at occiput	3½ "
Transverse diameter from zygoma to zygoma, from a point just anterior to articulation of jaw	4½ "
Distance from chin to vertex	6½ "

Her gait is peculiar; at first sight it seems to resemble that of paralysis agitans, but on more careful examination it is seen to resemble it only in the fact that the body is bent forward, and that the patient frequently runs. The feet are stamped rather heavily upon the ground, and her legs are moved in a very slovenly manner, but there is no real festination, nor are the knees bent to an unusual degree. She carries her thorax much more forward than is natural, and the head is thrust forward, though the neck is extended so that a straw hat placed on the top of the head when she walks has its brim

resting flat on her back. In fact, the position of her head is very like that of a quadruped.

Her movements are clumsy and, as a rule, slow. She takes a considerable time before, as it were, she decides upon performing any voluntary movement with her hands; and though she is quite capable of making rapid movements, she usually moves but slowly: for example, when the callipers were applied to her head for the purpose of measuring it she invariably raised her hand to remove the instrument, but so slowly did she do this that there was generally ample time to adjust it to her head before she took hold of it. She will, however, clap her hands and shake them, when pleased, quite rapidly. In clapping her hands, however, I have noticed that she, unlike a healthy person, holds her two hands in different, and often in awkward, positions, so that the two palms do not meet in such a way as to produce a sound.

The patient spends most of her time in running about the wards and garden, rarely sitting down except at meals.

Her temper is now better than it was two or three years ago, but she is still passionate, and, when thwarted, will kick and bite most violently. She cannot speak at all. The few articulate sounds she utters are meaningless. She, however, understands much that is said to her—much more, indeed, than would at first be supposed.

Some idea of her degree of intelligence can be gathered from the following incident: She was eating some sweets when the nurse said, "Go and fetch Maria (an epileptic idiot), and give her some too." She at once ran away—went out of the door of the ward, which she opened herself, and ran round the garden, in which there were at least twenty or thirty patients for the most part dressed alike. She went into all the corners and looked everywhere where she thought Maria might be; not finding her in the garden, however, she came back to the ward, still searching, going first into an adjoining room. When she at last discovered her sitting on the floor, she pulled her up and pushed her to the table, and put a sweet in her mouth; and she showed some slight but unequivocal signs of mortification when Maria, after all her trouble, would not eat it. Though she knows Maria and several other patients by name, she does not seem to know her sister when alluded to as "Emily"; nor does she know the nurse who for some years has constantly attended to her, when alluded to by name or spoken of as "Nurse." That she does recognise her is evident from the fact that she obeys her better than anyone else.

She also knows some few objects by their names. She is able to rub and dust the furniture; and if told to dust a chair, she will not, as a rule, operate on a table, or *vice versa*, though

she sometimes makes a mistake. When bidden, she will go to the cupboard and get her bonnet, which she knows from all the others, though they are made of the same material. If her bonnet is not in its place, she will carefully examine all those in the cupboard over and over again, and finally wander about the room looking for it.

Although she never makes any attempt to speak, she will, when given anything she likes, make a series of small courtesies, and will, when told to do so, clap her hands, which, as before stated, she does in a very clumsy manner.

She possesses but little power of attention, and if shown anything she is as likely as not to go away before the exhibition is complete.

She does not exhibit to the slightest degree any tendency to imitate the actions or behaviour of others.

She is very fond of carrying a piece of string or cloth about in her hand, but, strange to say, she seems to care no more about coloured objects than about others. I never have been able to notice that she liked a piece of red or yellow cloth better than a black or white piece, nor have I been able to obtain any evidence that she had any idea of numbers.

Her memory does not seem very active; in fact it seems much less perfect in her than in her sister. Though I measured her head one day (a process she disliked), she did not keep out of my way, as her sister did, when I returned the following day with the instrument; nor did she seem to remember that I had given her sweets. She seems to like music, but is not excessively fond of it.

I have ascertained that she is capable of experiencing, to some extent at least, the following emotions:—

Fear. She is very timid, and especially so of fire, and runs away from and screams at a lighted taper, though this is daily used to light the gas.

Affection she exhibits, to a small degree, towards several patients who take notice of her. She evidently likes to be with them in preference to others.

Rage she feels to a marked degree, biting and kicking the object of her anger.

She is revengeful, and will return to attack the offenders if prevented in her first attempt. After being angry, she is dull and sulky for some time, and mopes about, hanging her head. If scolded by the nurse, she shows signs of sorrow, and retires to stand in the corner.

She is possessed of a considerable degree of curiosity, and will inspect with interest anything new, and will direct the attention of others to it. As an instance of this, I may mention that on one occasion the patients were to have their

tea in the ward, the dining-hall being unavailable; both she and her sister ran to some one who entered the ward, and who had not seen the preparations, and pointed out the teacups.

Pleasure she shows by smiling and by laughter, and by running about with her arms flexed at the elbows, shaking her hands, and by uttering, from time to time, articulate but meaningless sounds.

She seems quite incapable of feeling sympathy, nor is she known ever to have exhibited jealousy. She will show her mortification if she is not given sweets while others are, but she never shows any illwill to those more lucky than herself. So far as is known, she has never exhibited any sexual propensities whatever.

As may be supposed from the above account, attempts to teach her have not met with much success. She has learnt to feed herself with a spoon, though all attempts to make her clean in her habits have failed utterly. She allows the saliva to run from her mouth.

She sleeps well. When asleep she lies on her side, curled up with the knees applied to the abdomen and the hands upon the chest; in fact, she assumes the foetal posture.

Her organs of the special senses are all in a perfectly healthy state.

Her heart and lungs are also quite healthy; her extremities are well supplied with blood. Digestion is satisfactorily performed, and the excretory organs are healthy.

Her muscles are well developed; she is pretty strong; her limbs are thick and short.

Her sexual organs are matured; she menstruates with great regularity, and her mammæ are largely developed.

Emily G., æt. eleven years, was admitted when only four years old. Previously to admission she had had convulsions. Her general health had not been nearly so good as that of her sister. When admitted she was small for her age, and had a head very much flattened posteriorly, and of relatively smaller size than her sister's. All the cranial sutures were closed. She was unable to talk; nor could she feed herself. She allowed the saliva to run from her mouth, and passed her dejections under her.

She was nevertheless lively, and liked to be noticed, but was timid and afraid of strangers, like her sister. She was also passionate.

Her general health was not good, and she was subject to bronchial catarrh. During the first year of her life at this asylum she had several attacks of diarrhoea, and several times was under treatment for chest complaints.

She however learnt to perform various acts, and could feed herself with a spoon, and became less dirty in her habits, and learned to understand much that was said to her.

Her health improved as she grew older. In 1873, that is, when she was five and a half years old, her head measured $13\frac{1}{2}$ in. in circumference. Since that time no great alteration has taken place in her habits or character.

Emily G. is now eleven years old. She is 3 ft. 6 inches in height, and weighs 44 lbs.

She bears a striking resemblance to her sister Anne.

Her head, like that of her sister, is very small.

The depression at the posterior part, described as being present in the head of Anne, is in her head much more marked (Fig. II. P.) Her palate is, like that of her sister, much arched, but not to so great a degree. Her teeth are in good order; she is about a year behindhand in her dentition. Her nose is prominent and her chin recedes, but the face is much narrower, and her expression is less like that of a beaver than that of a mouse. Her eyes, unlike those of her sister, which are small and deep set, are prominent.

Her usual attitude is even more stooping than that of Anne.

The measurements of her head are as follows:—

Greatest circumference	14 $\frac{1}{2}$ in.
Greatest antero-posterior diameter	4 $\frac{1}{2}$ "
Distance from auditory meatus over vertex to other meatus	8 $\frac{1}{2}$ "
Longest transverse diameter	8 $\frac{1}{2}$ "
Distance from root of nerve to most prominent point of occiput	7 $\frac{1}{2}$ "
Transverse diameter at mastoid processes	3 $\frac{1}{2}$ "
Distance from auditory meatus to middle of brow	8 $\frac{1}{2}$ "
Do. do. to prominent point of occiput	8 $\frac{1}{2}$ "
Transverse diameter from zygoma to zygoma, from a point just anterior to articulation of the jaw	3 $\frac{1}{2}$ "
Distance from chin to vertex	6 $\frac{1}{2}$ "

Her gait resembles that of her sister, but is altered to some extent by the presence of talipes varus of the right foot, for which she wears an instrument. Her movements are much more active and childlike.

Her general behaviour does not, however, greatly differ from that of her sister, but she is more often alone, and is fond of nursing a doll, which Anne will not do.

She is able to say a few simple words. For example, she says "tata" when going to bed. She knows even more people by name than her sister, but it has not been possible to teach her to dust the furniture. She, however, knows her own clothes, and will put some of them on.

Her power of attention and her memory are much better than her sister's.

She has no greater liking for bright colours than has her sister.

As an instance of her dislike for strangers, and as an example of her power of memory, the following incident may be related. She had been taken to the store room to be weighed. She saw there an idiot, whom she sometimes, though not often, saw at a distance in the dining hall. With him, when asked, she shook hands, but she screamed at the sight of the store keeper whom she never saw.

Like her sister, she has not the slightest idea of numbers, nor does she care about music; in fact she cares less about it than Anne does.

Affection she does not exhibit to so great a degree as her sister; nor is she so easily made angry, nor so violent when angry. She does not appear to be revengeful.

When scolded she is evidently sorry.

She smiles and laughs when pleased.

I have never noticed any evidence that she is capable of feeling compassion or sympathy.

Her mode of sleeping is exactly like that of her sister.

She is evidently scrofulous, and has had at various times enlargements of glands, &c.

Her heart and lungs are normal, however, and her digestion fairly good.

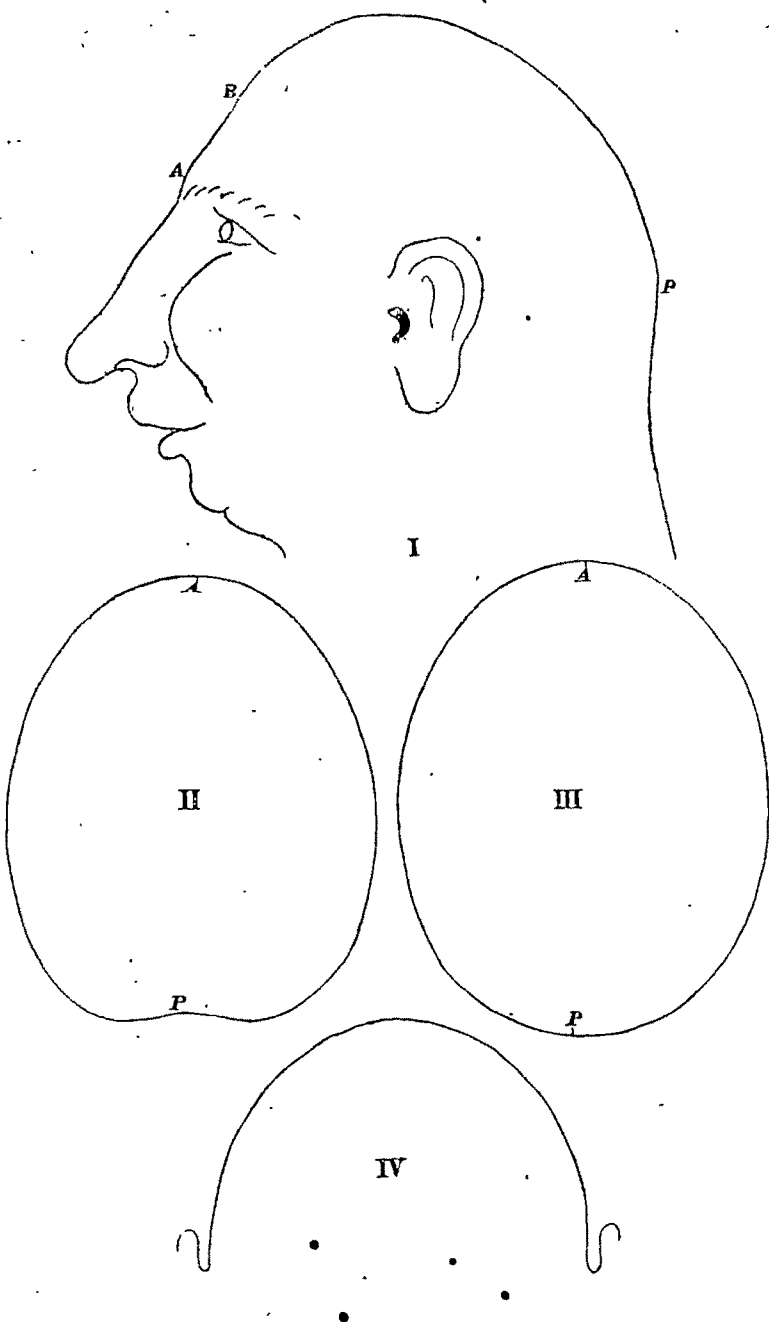
The annexed Diagrams are half life-size. They have been reduced from tracings obtained by accurately applying a strip of thin sheet-lead to the heads of the patients, in the same way as the cistometer is applied to the chest.

FIG. I.—Represents the profile view of the head of Anne G. The hairy scalp begins at B. (The features from the tip of the nose to the chin were not obtained by means of the cistometer, and have been simply added to complete the diagram. The positions of the eye and ear were obtained by accurate measurement.)

FIG. II.—Represents the outline of the head of Emily G., showing the depression of its posterior part.

FIG. III.—Represents the outline of the greater circumference of the head of Anne G. The letters A Q P correspond to the points marked by the same letters in Diagram I.

FIG. IV.—Represents the tracing obtained by applying the strip of lead to the head of Anne G., from ear to ear over the vertex.



EMBOLIC HEMIPLEGIA WITH OPTIC NEURITIS.

BY STEPHEN MACKENZIE, M.D.,

Assistant Physician to, and Lecturer on Pathology at, the London Hospital.

MATILDA D., aged 16 years, admitted into the London Hospital, under my care, March 19, 1878. She stated that she did not remember if she had had the usual infantile diseases, and that, to her knowledge, she was quite healthy until five weeks before admission. She then noticed a number of spots on her legs and feet, which lasted two weeks, and which, from her description, were probably of a purpuric nature. At the same time, she had frequent attacks of bleeding from the nose, from which she had not previously suffered. At the time of the eruption she had great pain in the shafts of her long bones, but she does not think any of her joints were red, swollen, or painful. She has had no shivering, but has suffered greatly from vomiting during her illness. She has not noticed shortness of breath. She became exceedingly weak, and had to keep her bed on this account for the two weeks preceding her admission. Her father had rheumatic fever four years ago; her mother died of consumption.

On admission, it was noted that the patient is a fair-haired girl, with blue eyes, slenderly built, sparsely nourished. She lies in bed comfortably, breathing without distress; perspiring freely. Her chest is well formed, and there is natural vesicular murmur throughout. The cardiac dulness extends from third rib to two inches below nipple, and from midsternum to nipple line. The impulse is diffused, but greatest at fourth left interspace. Both sounds of the heart are intensified, but no murmur can be detected. Her pulse is 160 per minute. Hepatic dulness normal; splenic dulness not increased, spleen cannot be felt. No œdema of any part. No arthritis. The pulp of the little finger of right hand is discoloured, hard, irregular, and shrunken, looking like dry gangrene; she says the second and third fingers were like this one; they are

slightly shrivelled but not discoloured. Her temperature is 102° F., respirations 48, urine free from albumen.

March 20th.—Complains of pain in shoulder, which seems to be in muscle; it is not increased by moving the joint: no redness or swelling. At apex there is noticed a loud systolic murmur, well conducted into axilla, the second sound over pulmonary artery being accentuated.

21st.—Complains of great pain over heart, shortness of breath; no pain in joints or bones.

22nd.—I dictated, "The heart is beating with extreme rapidity. There is a thrill at the apex, which appears to terminate with the impulse. There is a distinct bruit, which from its character I judge to be combined presystolic and systolic, but the pulse is beating at 150 per minute."

29th.—It was noted, the patient is free from pain. There is no evidence of arthritis. The pulse continues to be very rapid and the temperature irregularly high. There is an indistinct thrill at the apex, where there is a loud systolic murmur conducted into the axilla.

April 9th.—Since last note, the temperature has averaged 99° in the morning and 101° at night; pulse varied from 110 to 140. She complained yesterday and to-day of pain in the calf of the left leg. On examination, this part feels denser and more bulky than that of the other leg, and its circumference exceeds that of its fellow by a quarter of an inch. No discolouration of skin. The femoral arteries can be felt pulsating, but neither popliteal nor posterior tibial arteries can be felt on either side. Heart beating at 142, its impulse is accompanied by a thrill and a murmur. The latter is mainly systolic, but it also appears somewhat of a presystolic character; the rapidity of the heart's action will not allow of a definitive judgment on this point.

April 13th.—Brawny feeling disappeared from calf, but circumference still exceeds right by quarter of an inch.

April 18th.—Complains of intense throbbing pain in left side in region of spleen. Splenic dulness not below margin of ribs, spleen cannot be felt on account of the pain. She felt sick, and shivered slightly from cold last night, at the time the pain began; her teeth did not chatter. Has vomited the last two days after every meal. No alteration in physical signs.

April 23rd.—The pain has left her side two days: still quarter an inch difference between calves of legs. No pulsation in popliteal arteries. Temperature remains high, and pulse rapid. Heart sounds as before.

April 26th.—Patient had a slight attack of epistaxis this morning. When she awoke she had severe frontal headache.

April 27th.—Complained of headache all day yesterday, and vomited several times during the day. This morning, when she got up to have her bed made, she would have fallen had she not been caught by the nurse. The nurse says that at the time she noticed the patient's face was drawn to the right side, so as to expose her teeth. There was no convulsion or abnormal movement, but it seemed as if the patient had suddenly lost control over her muscles. There was no loss of consciousness. When seen by Mr. Major Greenwood this morning, he noticed that her left arm and hand were paralysed. On telling her to grasp with her left hand she could only do so in a very feeble manner. When she raised her upper lip to display the front teeth, there was a marked deviation of the corner of her mouth to the right; she also closed the left eye less firmly than the right. The tongue protruded to the left. There was no loss of power in the left leg, apparent on examining the patient in bed.

Evening.—The paralysis of arm is much more marked this evening. She cannot raise the arm from her side, and the power of grasping is quite lost. She can only just move her fingers. There is some loss of sensation in the left arm, for, on pricking it with a pin, she does not feel nearly so well as with the right arm. There is no marked loss of power in left leg. Both popliteal arteries can be felt pulsating this evening; the accuracy of this observation was tested by counting the pulse in these situations and comparing it with that at the wrist. The patient has complained of great pain in the front and back of head throughout the day.

April 28th.—This evening patient complains of pain of a throbbing character on both sides of her head. The paralysis of the left side is much more complete, and she is literally unable to move a muscle of her left arm. Loss of power in the left leg is for the first time noticeable. The patient is able to flex the leg only with difficulty; and on attempting to extend it, she can only do so with great effort, which causes tremor of the limb. Facial paralysis very slight.

April 29th.—Patient complains of headache, and of great numbness in her left hand, where, on testing, sensation is very deficient, the patient being unable to tell which finger is touched.

April 30th.—The eyes have been examined several times before without any marked alterations being detected. The examination is always attended with great difficulty, owing to her inability to fix her eyes. To-day the right eye is atropised, and there appears to be some swelling of the disc. The left eye is difficult to examine, as the pupil is undilated, whilst the movements of both eyes render any examination inexact.

May 2nd.—Headache less. She thinks she can move her leg a little better, otherwise is about the same: temperature remains irregularly high, and pulse very rapid.

May 4th.—Had slight attacks of epistaxis yesterday and to-day. Thinks she can move the leg a little more. Complains of epigastric pain, and her tongue is coated.

May 5th.—Patient feels better this morning, and for the first time is able to move her left arm to a very slight degree. The only movement she can make is slight flexion of the forearm: she cannot move her fingers in the least. She got out of bed during the night, when the nurse's back was turned, and is reported to have fallen down. There is still a perceptible difference in the power of the left and right leg.

May 7th.—Movement of the left arm and leg about the same. She thinks she feels better in the arm.

May 10th.—No change in the paralysis. Flexion is the only movement she is able to make with the forearm. Can slightly flex and extend left leg: a tremor is excited in the left leg when the least resistance is offered to her efforts of extension.

May 20th.—Her condition has altered but little since last date. Her temperature has remained high, her pulse quick; she has had one or two attacks of epistaxis, and has complained of epigastric pain. To-day it is noted that she can use the left arm a little more. She can raise the arm slightly from the bed, but cannot use the fingers in the least.

May 22nd.—This morning, on asking her to show her teeth, it is noticed that the mouth is not drawn nearly so much to right as previously. There is scarcely any deviation of tongue. Has more movement of arm, but cannot move fingers at all. Has increased movement in leg. The cardiac dulness has increased to the right of sternum. Both optic discs now noticeably swollen, but no hæmorrhages observed.

May 23rd.—Dr. Hughlings-Jackson examined the patient's eyes, and confirmed the observation that the discs were swollen.

May 24th.—A hæmorrhage noticed in the course of a secondary retinal vessel above the disc.

May 25th.—Mr. Couper examined the eyes, and reported: "Both discs are swollen: there is much opaque exudative change in the nerve-substance of the discs, and in the adjoining retina, concealing the choroid there. No hæmorrhages are visible. The amount of prominence of the discs cannot be definitely measured on account of the unsteadiness of the eyes, but the swelling is by no means extreme, and the above appearances accord more with neuro-retinitis than with choked-disc." I made an independent observation the same day, and dictated: "The changes have decidedly advanced since my

last examination, nine days ago. Whereas on the last occasion the appearance of the fundus was filmy, and veiled as it were, now there is marked exudation, prominence of discs, distension and tortuosity of veins, with burying of vessels in exudation. There is one small streaky hæmorrhage in the left eye, opposite the disc on its outer side, running in the direction of the nerve fibres. There is an irregular and larger hæmorrhage in the upper and outer quadrant of the right eye."

May 28th.—Has more movement in arm and leg. Swelling of discs about the same, but there are more hæmorrhages. In the right eye there is one with a white centre, and there are other smaller white patches.

May 29th.—Urine to-day contains a trace of albumen. It has been examined almost daily in expectation of such an occurrence, but none has been detected previously; there was none on the 27th. No blood in the urinary deposit.

June 1st.—Patient can read without difficulty; $1\frac{1}{2}$ Snellen.

June 5th.—Patient passed a bad night, being much distressed, crying a good deal, and sleeping but little. This morning she complains of nothing.

Evening.—When seen at 8.30 p.m. her condition was much the same as it had been for some time. She seemed quiet and composed, and she had been brighter, and had taken more interest in things about her during the day. She made no complaint. At 10.45 the house-physician was called to her, on account of an alarming attack of dyspnoea. He found her breathing with great difficulty, tossing about in a restless manner; her face had a very anxious expression, and her lips were blue. Stimulants were freely given, but she died at 11.30. Her temperature remained irregularly high, with slight morning remissions, and the pulse rapid, to the end of the case. The respiration became more rapid at the close, owing to the condition of the lung brought about by the failing heart.

Necropsy sixteen hours after death.

Brain.—Pia mater congested. No difference observed between the two hemispheres. Right middle cerebral artery pervious, but walls thick and lumen diminished. Brain tissue around artery stained of a yellowish colour, and slightly softer than other parts. Right corpus striatum and thalamus opticus a little softer than left but not discoloured. No changes in other parts of brain.

Heart.—Pericardium healthy, but contained an excess of straw-coloured serum. Mitral orifice constricted by large vegetations, so as to admit only two fingers. Valve thickened and covered with large warty fungating vegetations with constricted bases. Endocardium of left ventricle opaque; and attached to that covering septum ventriculorum, a small warty

vegetation, corresponding to one of the vegetations on the mitral valve, with which it came in contact when the ventricle was closed.

Lungs.—Pleuræ thickened in places, showing traces of old inflammation. No recent lymph. A considerable amount of fluid in each cavity. Lung substance dense and fleshy.

Liver.—Congested, with nutmeg appearance.

Kidneys.—Congested. There were several slightly puckered depressions on the surfaces of both, suspicious of old embolisms. No recent infarction. Capsules slightly adherent. No sign of interstitial or tubular nephritis.

Spleen.—Enlarged, weighing thirteen ounces. It was attached by its upper border to the under-surface of the left lobe of the liver, by which it was completely concealed. There were numerous infarctions, in different stages, scattered through the organ. One of large size, breaking down at its centre, in the upper part.¹

The treatment pursued in the case may be briefly summarised by stating that salicylate of soda was at first administered with the effect of reducing the temperature, but without modifying the action of the heart. Later, quinine in 3-grain doses, combined with a grain of opium, was substituted for it. Absolute rest in the recumbent position was enjoined, to save the heart work, but it appears from the notes that the injunction was occasionally disobeyed.

Of the many points of interest in the foregoing case, I propose here to remark only upon the paralysis and optic neuritis.

The patient, quite a young girl, the subject of ulcerative endocarditis, was suddenly seized with paralysis of one lateral half of the body. There could be no doubt that the paralysis was caused by the plugging of a Sylvian artery with something detached from the surface of the diseased endocardium. Upon the embolus reaching the Sylvian artery the patient at once lost a certain degree of power over the muscles of the opposite half of the body, but she did not lose consciousness. Most authorities agree that loss of consciousness is unusual in embolism of a Sylvian artery, though Niemeyer is a marked exception.² Loss of consciousness may occur, and be as complete as in severe hæmorrhage, but this is unusual. The paralysis affected the face, tongue, arm, and leg on the

¹ This position of the spleen effectually prevented the enlargement of the organ being appreciated during life. From the symptoms, splenic embolism was diagnosed; but the swelling of the organ, usually noticed under such circumstances, could never be detected. •

² 'Textbook of Practical Medicine,' 8th ed., vol. ii. p. 184.

side opposite to the blocked middle cerebral artery, but it did not affect them exactly simultaneously nor to the same degree. The facial paralysis was slight; it was chiefly of the lower part of the face, as is usual in hemiplegia, and it appeared early. The tongue was paralysed so as to be protruded to the paralysed side, but not so as to interfere with articulation. At the onset there was decided loss of power in the left arm and hand. The patient could only grasp feebly with the hand, but her doing so at all showed that, at this time, some power was conserved in the fingers. At the time when the paralysis was first noticed in the face and arm there was no loss of power in the leg, *apparent on examining the patient in bed*, a most important qualification, as a slight degree of weakness may exist undetected in the leg, if the patient cannot be made to stand or walk. It may be thought that the threatened fall when the patient was attacked was due to loss of power in the leg, but we only have the nurse's statement of her condition at the time, and the threatened fall may have been due to the shock of the embolism. About ten hours from the onset, the paralysis had deepened; the patient could not raise her arm nor grasp with her hand, and there remained only the coarsest movements of her fingers. It was now noticed that sensation, which at first was unaffected, was diminished in the left arm. On the following day the paralysis of the left arm was complete, the patient being literally unable to move a muscle of this limb. It was now noticed, too, that the left leg was distinctly weakened, and sensation in the left arm had still further diminished. Six days from its first appearance the paralysis began to decline. The leg, the last to be affected, was the first to recover power, and three days later slight movement returned in the arm. Improvement proceeded gradually and steadily, the leg recovering more and quicker than the arm. Of the individual parts of the upper extremities the upper arm recovered more than the forearm; whilst at the time of her death, five or six weeks from the commencement of the hemiplegia, she had not regained the slightest power of moving the fingers. The facial and lingual paralysis gradually disappeared. It will be thus observed that the most voluntary or specialised parts were affected the earliest and the most severely in the progress of the paralysis, and that recovery took place in an inverse order. Thus at the time of the patient's death, whilst the leg and the arm had to a very great extent recovered, the fingers, the most specialised parts of the extremities, had regained no power whatever. This sequential progress of and recovery from the paralysis illustrates very characteristically the law insisted on by Dr. Hughlings-Jackson, that "from destroying lesions of the cerebral nervous centres, parts suffer the more as

they are voluntary or special, and the less as they are automatic or general. Recovery follows the reverse order; the more automatic parts recover first."¹

The definite sequential development of the hemiplegia appears to me to point to one of two occurrences. Either the plug—whether a detached vegetation or a piece of fibrine—did not close the channel of the artery in the first instance, but on the artery becoming subsequently plugged by the accretion of fibrine, or coagulation of the contents of the artery, the anæmia of the vascular territory became more and more complete, and the loss of function proportionately greater: or, as appears to me more probable, the embolus, consisting only of fibrine detached from vegetations or roughened endocardium, plugged the artery completely in the first instance, and the progress of the paralysis was due to the collateral fluxional œdema induced thereby. Kossuchin² has shown that when the circulation of an artery is suddenly arrested, there occurs ischæmia and narrowing of the vessel beyond the obstruction even to complete arrest of the circulation. Next there occurs a gradual squeezing of the blood out of the capillaries widened by collateral fluxion into the capillaries bordering on the district of free blood circulation, and this results in the production of hæmorrhages by diapedesis. The hæmorrhages do not depend alone on alterations resulting from arrest of the circulation, but also on the increased lateral blood pressure in the district bordering on the collateral fluxion, where they are noticed as early as from four to six hours after closure of an artery. I think the gradual progress of the paralysis, and the implication of the sensory functions subsequent to loss of motion, are best explained by the gradual development of the embolic process.

At the *post mortem* examination the channel of the artery was found restored, thus explaining the recovery from the paralysis. The recovery was not complete, and this was in accordance with the condition of the brain tissue supplied by the artery, which was still somewhat softened and discoloured. Had time been given, probably the paralysis would have entirely disappeared. Though no plug was found in the Sylvian artery, there could be no doubt that there had been one there. The walls showed signs of some change in them, and there was softening of the parts supplied. Embolisms were found in other organs. The complete disappearance of the plug inclines me to the belief that it was a piece of fibrine and not a vege-

¹ Clinical Lecture on a case of Hemiplegia. *Brit. Med. Journ.* 1874, vol. ii, p. 99.

² Zur Lehre von dem embolischen Infarcte. *Virchow's Arch.* lxvii. s. 449.

tation, for the former would more readily undergo disintegration and absorption.

With reference to the optic neuritis, I may mention that it is an extremely rare effect of embolism of a cerebral artery. My colleagues, Dr. Hughlings-Jackson and Mr. John Couper, who saw the case, and whose experiences are very large, had never previously seen neuritis from embolism; neither had I. Dr. Broadbent¹ has recorded the only case I know of where double optic neuritis occurred from embolism of a cerebral artery; and it is important to remark that in his case also the patient was the subject of ulcerative endocarditis. He writes: "I may again note the association of double optic neuritis with cerebral embolism, hazarding the suggestion that its non-occurrence in most cases may have the same explanation as the rarity of loss of sensation, and may be due to the fact that the usual cerebral embolism is of the Sylvian artery. Optic neuritis, however, goes rather with kinds of disease than with seats." Dr. Clifford Allbutt writes: "Embolism does not give rise to any definite eye mischief, so far as I know, unless it be followed by extensive cerebral softening. The contrary is stated by some writers; and I myself thought it likely that immediately after the accident, when the internal carotid was propelling blood over an area suddenly diminished, there might be some evidence of increased arterial tension, either in dilated vessels or in some degree of effusion. In one or two cases I have noticed some degree of haziness about the borders of the disc and vessels, but nothing that I could with a good conscience call a distinctly morbid state."² Leber³ speaks of neuritis (papillitis) as of exceedingly rare occurrence from cerebral softening of embolic origin. He gives no case of the kind, and doubts whether, when it occurs, the neuritis is really due to the embolic process, or to the disease which gives rise to it. Galezowski⁴ mentions a case where circumscribed softening of the brain, not stated to be embolic, caused optic atrophy; and mentions that Bernhardt⁵ has recorded two cases of softening of brain, one due to embolism of the communicating and Sylvian arteries, with atrophy of the optic nerves. Galezowski, in another place (p. 226), writes, "When the Sylvian artery is obliterated, the central organs of vision are not necessarily affected: that is why we do not generally

¹ *Trans. of Clinical Soc.*, vol. ix. p. 68.

² 'On the Use of the Ophthalmoscope.' Macmillan and Co.

³ Von Graefe und Saemisch, 'Handbuch der gesammten Augenheilkunde.' Band v. Hälfte 2. Theil v. Hälfte 2.

⁴ 'Traité Iconographique d'Ophthalmoscopie.' 1876, p. 224.

⁵ 'Berliner klinisch-Wochenschrift,' 6th Sept., 1875.

find any alteration of the papilla of the optic nerve; and the vision is not disturbed. But if embolism or thrombosis occurs in the middle meningeal artery, it may induce an atrophic process in the optic nerve, corresponding to the paralysed side." He probably means of the side corresponding to the *lesion*, for he mentions a case he saw with Professor Charcot, at La Salpêtrière, of a young girl between eighteen and twenty years old, the subject of incomplete right hemiplegia with aphasia, who had atrophy of the left papilla. He gives no case of neuritis, unilateral or bilateral. I have not searched all authorities on the subject, but it is clear from those I have quoted that double optic neuritis is a very rare consequence of embolism of a cerebral vessel. It is equally important to bear in mind the rarity, and the occasional occurrence, of neuritis from this cause. There was nothing that I can perceive peculiar to this case which would account for the neuritis supervening upon embolism. It will be observed that the sight was but little disturbed; the patient complained of no defect of vision.

I am indebted to Mr. Major Greenwood for many of the notes of the case.

A CASE OF RIGHT HEMIPLEGIA, HEMIANÆSTHESIA, AND APHASIA, HAVING FOR ITS PROMINENT ANATOMICAL LESION SOFTENING OF THE LEFT LATERAL LOBE OF THE CEREBELLUM.

BY RINGROSE ATKINS, M.A., M.D.,

Medical Superintendent, District Lunatic Asylum, Waterford.

THE particulars of the case which I record in the following pages are of interest, as illustrating the very anomalous occurrence of right hemiplegia, hemianæsthesia, and aphasia, accompanying a destroying lesion of a portion of the cerebellum, without the simultaneous existence of any disease in the cerebral cortex or hemispheres sufficient to account for these symptoms; and the case thus becomes of importance as bearing on the recent views put forward by certain physiologists regarding the diffusion of the functions of the brain in contradistinction to the doctrine of localisation; though, as Professor Ferrier has remarked, exceptional instances of this kind do not carry with them the same weight as would be carried by the converse of the condition above mentioned, that is, by a destruction of certain regions, in which, according to the latter doctrine, certain functions are supposed to reside, without the abrogation of such functions.

Murtagh Twomey, aged about 38 years, admitted into the District Lunatic Asylum, Cork, May 8, 1877.—The patient was unmarried, and had been for many years employed as a handy man, residing in the suburbs of Cork, his father before him having been in the same employment. Since his boyhood he was noticed to have been of an excitable disposition, and at times odd and eccentric in his habits and manners. In his youth he had a fever and subsequently became epileptic, the fits, of a mild character, seizing him occasionally. He was somewhat intemperate, and sometime since had a severer epileptic

seizure than usual, followed by right hemiplegia and aphasia, which lasted three weeks, complete recovery both of speech and motor power ensuing. His parentage disclosed no hereditary tendency to mental derangement or nervous disease. Sometime before his admission to the asylum he became unusually excited, and occasionally had paroxysms of violence; his memory was noticed to be defective, he mistook evening for morning, and delusions became developed; he fancied himself possessed of a considerable sum of money, and desired to go to London to set up a hotel; finally, he became so irascible and quarrelsome, without any provocation, and his actions betrayed such evident mental derangement, that he was sent to the asylum. On admission he was found to be talkative and restless, generally good humoured, but passionate if crossed or at all excited. His features were marked with a weak and facile expression, and he spoke in a simpering tone, an almost constant silly, self-satisfied smile overspreading his face; his memory seemed partially affected, he could however state his past history, where he came from, and what he had been employed at. When allowed to wander from any given point his conversation became quite irrational and partially incoherent, he says he is "about to receive thousands of pounds, and that he is immediately going to London." He was very averse to remaining in the asylum, and appeared to ridicule the idea of being a fit subject for detention there. Physically he was fairly healthy looking, his muscular development was poor, and, though by no means emaciated, he was rather thin than otherwise. The motor and sensory nervous systems were at this time apparently quite intact; he walked firmly and rapidly when requested, could turn sharply, and showed no indications whatever of any loss of power or incoordination in either limb; his manual grasp was normally powerful. Nothing amiss was detected in any of the bodily organs. On May 14th he was noted to have become very excitable and restless; without any reason or provocation he struck a fellow patient, and took to walking up and down the corridor of his ward, talking threateningly and noisily, with intervals of passionate crying. This paroxysm soon subsided, and he continued as above detailed, making himself useful in the ward, until the morning of June 8th, when he was found to have become, during the night, affected with right hemiplegia and complete aphasia, having gone to bed the previous night to all appearance in his usual condition. When examined in the morning, he was found to be quite unconscious, very drowsy, but not entirely comatose, as, on speaking loudly to him, he opens his eyes, and gazes around him for a few moments with an unmeaning vacant stare. The pupils are of

normal size, the irides mobile. He cannot articulate a word, nor does he emit any sound, and the right arm and leg are perfectly flaccid and helpless; sensation is completely gone over the whole of the paralysed side. The temperature in the right axilla was 101.2° , that in the left 102° . On the following day he was more drowsy, the paralytic condition being unchanged; he swallowed liquid food readily. On the 12th he was brighter, and showed some indications of returning consciousness, no change in the condition of the limbs. He smiled when spoken to, and seemed partially to recognise those around him. On the morning of the 13th he suddenly became affected with unilateral right-sided convulsions, which occurred and were repeated every five minutes. At 10.30 A.M. a spasm commenced in the ocular muscles and occipito-frontalis, travelling downwards, and seizing upon those of the paralysed arm and leg, terminating and lingering longest in the zygomatici and masseter of the right side. Forty grains of bromide of potassium, with 10 grains of chloral hydrate were at once administered, and rapidly checked the convulsions. On the 14th he appeared again somewhat improved, the attendant reporting that "he had spoken to him." I, however, did not hear him speak, and could not bring from him any articulate sound. The man continued thus, without any increase in the motor power, or any change in the condition of the muscular groups of the affected limbs, which responded to the faradaic current, for two days, his general condition being at one time favourable, and again at another worse, until the evening of June 16th, when, without any fresh or further symptoms developing, he succumbed. For some little time previous to death he perspired copiously.

Autopsy two days after death.—On incising the scalp and cutting through the calvarium, the latter was found to be thickened and dense, the diploe being replaced by osseous deposit. The dura mater was not adherent to the bone, its vessels were full of blood. The anterior three-fourths of the great longitudinal sinus contained a decolorised stringy clot which could be drawn out; the posterior fourth contained fluid blood. The dura mater was adherent to the arachnoid and pia mater over the region of the superior parietal lobule of both hemispheres by corpora pacchionii. The vessels of the arachnoid and pia mater were distended with dark-coloured fluid blood. About three ounces of sanguinolent fluid escaped during the removal of the brain. The vessels at the base of the organ were atheromatous. At the junction of the vertebrals, to form the basilar, was a thickened yellow patch on the left side of the vessel, the size of half a grain of maize; on the anterior part of the basilar there were

also slighter patches of disease. Neither of the internal carotids was effected. On the right middle cerebral were several spots of atheroma; the left was almost free, as were the dividing branches of both to their minute ramifications. On the right anterior cerebral was a small patch. No embolus or other plugging of the vessels could be detected even to the minute divisions of the middle cerebrals. The pia mater was thickened, milky, and opaque, where it bridged the fissura Sylvii and inferior aspect of the longitudinal cleft. The apices of the temporo-sphenoidal lobes and the orbital lobule were flabby, and to the touch diminished in consistence. On section the grey matter presented nothing coarsely abnormal; the white matter of the corona radiata, beyond being somewhat diminished in consistence throughout, and easily breaking down under the pressure of the finger, especially at the external boundary of the lateral ventricles presented nothing abnormal. Both opto-striate bodies were flabby and flattened, the posterior extremity of the left optic thalamus being more markedly so than elsewhere, as was best seen when the organs were looked at horizontally from behind, the latter then appearing to have lost to a certain extent its normal plumpness and rounded contour. The third ventricle was widened, and its peduncles presented a dirty yellowish colour; the commissures were intact. On repeated sections no focus of softening or other localised lesion was found to exist in either the extra- or intra-ventricular nuclei of the corpora striata. The surfaces of the hippocampal eminences were diminished in consistence, but beyond this general flabbiness of tissue (which may have been due to *post mortem* change) no localised lesion, with the exception of the above-mentioned atrophic condition of the posterior extremity of the left optic thalamus, could anywhere be detected in either cerebral hemisphere. The inferior frontal convolutions, with those surrounding them, of both hemispheres were carefully examined microscopically by repeated section, but with negative results, the grey substance of the cortex and the medullary matter subjacent being quite similar in appearance and consistence to that elsewhere, and presenting to the naked eye no appearance of disease. The left lateral lobe of the cerebellum was found to be the seat of marked disease, being so softened and broken down that a considerable gap was produced in its external border, where the tissue was entirely disorganised and destroyed. The spinal cord presented nothing abnormal to the naked eye. Portions of the brain and spinal cord were placed aside for future microscopical examination, but unfortunately got spoiled in preparing, during my absence from home, therefore I regret that, so far as the microscopical

pical examination could have thrown further light on the case, the report is imperfect. Taking, however, the coarse lesions, we have here a case presenting clinical symptoms pointing strongly to cerebral mischief, and that of a localised character, while the autopsy fails to reveal lesions, either as regards position or character, such as we would have expected to find, according to the modern doctrines of localisation. On the contrary, we have a lesion of a remote region of the encephalon, none of the ordinary symptoms of which were indicated during life. The experimental inquiry into the functions of the cerebellum has occupied the attention of many observers in different countries and at different times; and though certain differences exist, yet it would appear that since the well-known experiments of Flourens first directed attention to the influence of this organ on motor co-ordination, more unanimity exists as to the part which it plays in the scheme of the nervous system, than does that of the higher centres. It is not my intention here to enter upon the results of such experimental inquiries, it will suffice for my present purpose to indicate what they have shown the functions of the cerebellum not to be, in relation to the case under consideration. Ferrier states ('Functions of the Brain,' p. 111) that though disputed by some, it seems to be established beyond all question, that, while interfering with the mechanical adjustment against disturbance of the bodily equilibrium, lesions of the cerebellum do not cause paralysis of voluntary motion of the muscles which are concerned in these actions. He adds that it has been observed that tumours or apoplectic extravasations into one half of the cerebellum frequently coincide with hemiplegia of the opposite side of the body, but in these cases, as Vulpian has rightly indicated, the hemiplegia is not the result of the cerebellar lesion as such, but of compression of the subjacent tracts of the pons and medulla. As these decussate in the medulla oblongata, the effect of a tumour of the lateral lobe of the cerebellum is paralysis of the opposite side of the body. Lesions which do not exert such a compressing influence on the subjacent tracts do not cause hemiplegia on the opposite side of the body. How can the facts of the case above recorded be reconciled with this statement? Here there was no tumour, no apoplectic extravasation, or any lesion which could exert a compressing influence on the decussating tracts in the medulla oblongata, and yet complete paralysis existed on the opposite side of the body without any lesion which can at all account for it otherwise. Again, the cerebellum was at one time regarded as the *Sensorium commune*, of seat of common sensation. Nowadays, however, the results of experimental physiology appear to give this opinion an emphatic denial. "Flourens and

Vulpian have observed no indications of cutaneous anæsthesia in animals deprived of the cerebellum ;” and Ferrier’s experiments on monkeys are “in complete accordance with their results.” These facts, taken with the data hitherto drawn from human pathology, appear to afford decisive evidence against the view that cerebellar lesions cause loss of tactile sensation; yet in the present instance we are met with an apparent contradiction to this complete cutaneous anæsthesia accompanying the motor paralysis. Indeed, the condition of affairs is so entirely opposed to modern teaching that I would feel inclined at once to reject the cerebellar lesion as playing any part in the production of the symptoms, without being able at the same time to offer any further explanation, were I unaware that such an authority as M. Brown-Séquard has spoken thus : “. . . that a disease located on one side of the brain can produce paralysis on the same side, be that disease in the medulla oblongata, the cerebellum, the pons varolii, or in any other part of the brain.” Read by the light of such a statement, the hypothesis, therefore, cannot be overlooked that the lesion of the cerebellum may have produced the paralysis as M. Brown-Séquard would have it, by an irritation restraining and arresting the action of nerve cells, at a distance from the seat of the lesion (inhibition). If the cerebellar lesion, then, is to be credited with a causal influence, the case would appear to support two of the propositions recently enunciated by M. Brown-Séquard ; for we have, in the first place, symptoms produced suddenly by a slowly and gradually developing lesion, as that in the lateral lobe of the cerebellum was ; and, in the second place, we have a lesion in a remote region of the encephalon, giving rise to symptoms which are well known to be produced by diseased conditions affecting entirely different portions of the organ. These views of M. Brown-Séquard are, comparatively speaking, but recently promulgated ; and should they have any foundation, not only the more modern doctrines of localisation, but also the older and hitherto firmly believed in theory of the crossed action of the cerebral hemispheres must be at once and for ever abandoned. With all respect, however, for their great originator, I hold that we cannot accept these views with the degree of proof at present forthcoming. Many of the experiments on which they were founded were made, as is well known, before those finer methods now employed by experimental physiologists were elaborated, and on animals too low in the scale to afford trustworthy comparison with similar conditions in man ; and many of the pathological observations are old, and open to the same objection. However, they are now at the bar of science, and time and further research will show sooner or

later whether they shall stand or fall. Passing now from the cerebellar lesion in the case of M. T., let us glance for a moment at the condition of the brain itself. Although there was no coarse disease in the intra- or extra-ventricular nuclei of either opto-striate body, or in the convolutions (and microscopical examination is unfortunately wanting), yet it will be remembered that I have recorded a flattening of the normally rounded and plump posterior extremity of the left optic thalamus: in fact, a certain degree of external wasting of this organ. Is this condition at all significant? Does it bear any relation to the hemianæsthesia accompanying the motor paralysis? In view of the sudden and simultaneous occurrence of both these morbid conditions, as if depending on one common cause, it becomes difficult, if not impossible, to answer these questions satisfactorily. Experimental inquiry has shown, and many carefully observed cases recorded by Charcot, Türck, Bourneville, Hughlings-Jackson, Crichton-Browne, and others, indicate that the optic thalami are concerned with the function of sensation. Many cases have occurred where uncomplicated lesions of the thalamus of considerable extent were accompanied with anæsthesia, more or less complete, while in others this symptom was absent. Ferrier thinks that in the extent of the lesion lies the key of the explanation of the differences in the clinical symptoms of disease of this ganglion. Here, as I have already stated, there was no localised softening or disorganisation of tissue, merely a surface wasting, hence it is not easy to estimate its influence in the production of the anæsthesia; judging it by Ferrier's opinion it would be but slight, as the partially atrophic condition did not extend deeply, or disease affect the central masses of the ganglion. Keeping in mind, however, the morbid condition occurring elsewhere, this state of the optic thalamus, together with the probable degeneration which existed both in its histological elements and in those of the corpus striatum, which the man's previous history and condition, both bodily and mental, previous to his fatal seizure rendered likely, give some show of support to the hypothesis that the functional activity of these ganglia, already weakened, were arrested by the irritative lesion in the cerebellum, the route by which the motor impulses travel downwards from the "leading" speech centre being at the same time interrupted, aphasia resulting. It is to be remarked that such an hypothesis, while admitting that a lesion in any portion of the encephalon can give rise to constant symptoms, does not negative the existence of definite centres, the indefinitely situated lesion causing by its irritation an irradiative influence on, and a consequent inhibition of the functional activity of such centres. These hypotheses, though

they may satisfy the mind for a time, are after all mere speculations which do not throw any real light on the subject. We must be content at present with recording such cases; and, though we may be led to speculate thereon, we can only hope that extended research into now hidden domains may in time afford the real explanation which is at present concealed from our view.

Abstracts of British and Foreign Journals.

The Brain of the Sumatran Rhinoceros.—In the *Transactions of the Zoological Society*, vol. x., Professor GARROD describes (p. 411) and gives four figures (Plate lxx.) of the brain of the Sumatran rhinoceros (*Ceratorhinus Sumatrensis*), the original of which may be seen in the Museum of the Royal College of Surgeons. Professor Owen had briefly described (*op. cit.*, vol. iv., pp. 58 *et seq.*) and figured (Pl. xix.-xxii.) the brain of the Indian rhinoceros (*Rhinoceros unicornis*). This, though greater in size, is simpler than that of the Sumatran genus. "So complicated," says Professor Garrod, "and numerous are the convolutions, that the general type-plan of their disposition is, to a considerable extent, disguised. They very closely resemble the same in the Equidæ, as might have been surmised." As a guide to the apparently chaotic meanderings of the convolutions as represented in the plate Professor Garrod comes to our aid with a woodcut, representing the general direction of the sulci on the upper surfaces of one of the hemispheres (the left) of the brain. The fissure of Sylvius is stated to form an open angle, at the bottom of which are situated a number of small convolutions radiating from a point, which probably represent the Island of Reil.

The Brain of the "Cape Hunting Dog."—In the *Proceedings of the Zoological Society*, 1878, part ii. (March—April), Professor GARROD briefly describes (p. 374), but does not figure, the brain of the "Cape Hunting Dog" (*Lycæon pictus*). This, he states, is "perfectly dog-like," resembling that of the wolf (*Canis lupus*), as figured by Leuret and Gratiolet in their well-known work, 'Anatomie comparée du Système nerveux,' Pl. iv., Fig. *Loup*, Paris, 1839:57.

In the same paper there is a short description (p. 375), also unillustrated, of the brain of another member of the *Canidæ*, viz.,

Nyctereutes procyonides. This, too, is said to be "perfectly caniform." There is scarcely any tendency in the second gyrus to form an antero-superior angle, and the sulcus between gyri 3 and 4 is not quite parallel to the great longitudinal fissure, it diverging slightly from the middle line as it goes forward. In these respects the brain more resembles that of *Canis vulpes* (*vide* Leuret and Gratiolet, *op. cit.*, Pl. iv., Fig. 2, *Renard*.) than those of *C. familiaris* or *C. lupus*.

A Case of Absence of the Corpus Callosum in the Human Brain.—Dr. EICHLER, assistant in the Pathological Institute at Kiel, records in the current number of the *Archiv für Psychiatrie* (Band viii., Heft 2. s. 355), a case of the above form of arrest of development, and illustrates it by a plate (Taf. x.) of three figures. The number of recorded instances of absence of the *corpus callosum* in the human brain is very small. Dr. Sanders, when publishing a case seen by himself, states that ten such had been previously noticed—Ueber Balkenmangel in menschlichen Gehirn., *Archiv für Psychiatrie*, Bd. i. s. 128, and Taf. i.-iii., while Dr. Knox—Description of a Case of defective Corpus callosum, *Glasgow Med. Journ.*, April 1875, p. 227, mentions fourteen instances of the occurrence of this anomaly. To these should be added a case recorded by Professor Turner in the *Journal of Anat. and Phys.*, vol. xii. p. 241, of which an abstract appeared in the first number of *BRAIN*.

That which renders the case mentioned by Dr. Eichler particularly interesting is, that notwithstanding so serious a defect, there was during life no psychical derangement.

The Brain of the Selachia.—Dr. ROHOU publishes in the *Denkschriften der k. k. Akad. der Wissenschaften*, Bd. xxxviii. s. 43, Taf. i.-ix., Wien, 1878, an important paper, entitled *Das Centralorgan des Nervensystems der Selachier*. In the appended bibliography there is omitted a valuable paper, contributed to the *Journal of Anat. and Phys.*, vol. x. p. 76, Pl. vii., 1876, by Messrs. Jackson and Clarke, on the Brain and Cranial Nerves of *Echinorhinus Spinosus*.

Two important papers have recently been published upon the Nervous System of the *Medusæ*. OSCAR and RICHARD HERTWIG. *Das Nervensystem und die Sinnesorgane der Medusen*. Illustrated by ten plates. Large 4to. Leipzig, 1878.

G. J. ROMANES.—Further Observations on the Locomotive System of Medusæ. *Phil. Trans. Roy. Soc.*, vol. clxvii, p. 659. With two plates.

The Brain of *Procamelus Occidentalis*.—Professor COPE, the American palæontologist, describes, in the *Proceedings of the American Philosophical Society*, vol. xvii. p. 49, casts, made after the manner of Professor Gervais of Paris, of the interior of the cranial cavity of *Procamelus occidentalis*. A plate of three figures illustrates the upper, lower, and a side view of one of the casts. The brain displays the character of the older type of *Ruminantia*, although not materially smaller than that of the llama—the South American representative of the camel—an animal which it equalled in general proportions. Professor Cope concludes that while the arrangement of the convolutions of the anterior lobes of the hemispheres is more simple than in any recent Ruminant, that of the middle and posterior lobes is essentially similar to that characteristic of this order of mammalia.

J. C. GALTON.

Contributions to the Physiology of the Spinal Cord. Effects of Compression of the Aorta on the Circulation.

SIGMUND MAYER. (*Acad. d. Winerisch. zu Wien Sitz.* March 14, 1878.) —Mayer, following the method of Kussmaul and Jenner, has investigated the effects of the anæmia (or, at least, oligæmia) of the spinal cord, consequent on compression of the arch of the aorta after it has given off the left subclavian, without injury to the pleura or other important structures.

The effects of compression of the aorta depend essentially on the duration. At the end of from 6 to 8 minutes' compression, the blood-pressure sinks slightly below the normal standard, and then rapidly regains it. This result is remarkable, when considered in reference to Stenson's experiment, in which, after compression of the aorta, complete motor and sensory paralysis continues for one to two minutes. We may therefore conclude that the chief bulk of the vaso-constrictor nerves in their course through the spinal cord are influenced by anæmia in quite a different manner from the motor and sensory tracts of the extremities. If we assume that it is expressly the grey matter of the spinal cord which is affected by the anæmia in Stenson's experiment, it is to be concluded that the paths for a large proportion of the vaso-

constrictor plies (which in the rabbit run in the splanchnics) stand in no functional relation to the grey matter.

The phenomena are different when the aorta has been compressed for a longer period—8 to 16 minutes. In this case, after the removal of the constriction, the blood-pressure sinks rapidly to the low grade which is observed after bloodless annihilation of the cerebral functions or section of the cord high up. After a few seconds, the blood-pressure again rises to the normal point, or even higher, sinks low again suddenly, and finally rises slowly, in a wave-like manner, to the normal point, at which it remains.

This rapid sinking of the blood-pressure in consequence of long-continued anæmia of the spinal cord is to be attributed to temporary paralysis of the spinal tracts between the cerebral vaso-constrictor centre and the peripheral muscular coats of the arteries.

If the compression is kept up for a longer period—from 20 minutes to 3 hours—and then removed, the blood-pressure sinks progressively till the circulation stops and death ensues. This result is due to a marked paralytic dilatation of the whole of the peripheral vessels. Even in this long-continued cessation of the aortic circulation, the cardiac action, respiration, and the cerebral functions continue. This fact has an important bearing on the metabolic relations between the brain and the blood, when it is considered that the circulation through the abdominal organs (liver, kidneys, &c.) may be completely stopped for hours without inducing cerebral disturbance.

The anterior transverse temporal Gyrus (*Gyrus temporalis transversus anterior*). By Professor RICH. HESCHL. Vienna, 1878. Pp. 14.—The temporo-sphenoidal lobe of the human brain possesses a surface (looking inwards and upwards towards the insula) which as a rule has been little noticed. On this aspect several (occasionally as many as five) parallel gyri may be distinguished, running from before and laterally backwards towards the middle line. They may be termed the 'transverse temporal gyri.' Of these the most constant and best developed is the anterior transverse gyrus. It springs from the first temporal convolution (T_1 Ecker), about the middle of the lower margin of the fissure of Sylvius, and frequently the first temporal convolution passes completely into it in the form of an arch, so that the posterior half of the upper margin of the temporal lobe is formed by the second temporal convolution (T_2 Ecker). This arrangement occurs more frequently in the left

than in the right hemisphere (18 : 1), and more frequently in men than women (4 : 1). The anterior transverse temporal gyrus is distinguishable at a period at which none of the other convolutions are recognisable. Already at the beginning of the fifth month, it may be seen plainly as a gentle elevation of the lower margin of the still open Sylvian fissure.

H. OBERSTEINER.

Variable and Momentary Paralysis due to Lesions of the Grey Cortical Substance of the Brain. (*Gazette des Hôpitaux*, June 15th, 1878.)—The study of the localisation of disease in the brain, has of late emerged from comparative obscurity, thanks to the rapid strides made in experimental and clinical medicine. Although much, one might say, almost everything, is to be done, there are yet cases in which we can, from the symptoms, approach to a precise and determinate differentiation, if not of the exact point and limit of the lesion, at least of the zone and region mainly affected in one or other hemisphere. We may say that the physiognomy of a paralysis will be altogether different, according to the seat of its producing lesion. If the destructive lesion be amid the motor or anterior fibres of the bed of white substance, close to the peduncles, termed the *internal capsule*, the paralysis will be permanent, invariable, and incurable; while, on the contrary, if the lesion affect the grey covering of the convolutions, or, in other words, the cortical bed near the fissure of Rolando, the paralysis observed will be essentially variable, and probably transient, disappearing at the end of a few days. This variability and slight persistence of the paralysis, due to alterations of the superficial grey substance in the motor areas, MM. Carville and Duret have observed in their vivisectional experiments, and have explained by the possible substitution of the destroyed portions by portions still intact belonging to the same cortical bed. The following case bears out this view, and serves to confirm clinically the localisation experiments made upon animals.

G. G., male, æt. 32, admitted 30 Nov., 1877, under the care of M. Empis for chronic pulmonary tuberculosis, complicated by pneumothorax, and also having a white swelling of the right elbow. In spite of these several lesions, he seemed in good condition. In March, quite unexpectedly, peculiar phenomena occurred, which immediately pointed to tubercles of the brain. Several general epileptic attacks, leaving behind no particular trouble, neither accompanied by fever, vomiting, nor cephalalgia were the only symptoms of

cerebral lesion. These attacks occurred at intervals, and without any regularity. After the third attack the patient was seized by a complete paralysis of the left upper extremity. This brachial monoplegia occurred on April 18th, three weeks after the first epileptic attack, and at once suggested a cortical lesion, although the other characters of cortical paralysis were slow to develop themselves. Two days after the paralysis the patient, who during the night had been quite unable to move the limb, raised it without much difficulty, except that the movement was slow and without energy. The evening of the same day the paralysis was absolute, and this variability was observed on several following days. The intelligence was perfect, and the cephalalgic pain nil. The left lower limb, at first unaffected, in a few days presented a certain degree of paralysis, but these paralytic phenomena were of short duration. There was noticed at the same time a slight degree of superior facial paralysis. The paralysis of the arm was the most marked, and presented all the characters of a cortical paralysis, being partial, clearly limited during a certain time to the upper limb, variable and transitory, for at the end of fifteen days the patient fed himself with the left hand, although there still remained a certain degree of weakness on that side. There was never at any time any disturbance of sensation. Such were the principal characteristics of the clinical history of the patient. The lesion found at the autopsy completely confirmed the diagnosis of cortical paralysis. In fact the heap of tubercles near which the cerebral substance was remollescent, formed a large tract, extending along the superior edge of the right hemisphere nearly the whole length of the parietal lobe, and which bridged over the fissure of Rolando, touching the ascending frontal convolution on a level with what has been defined as the motor centre of the superior extremity. At this level especially, the tubercular mass occupied the whole thickness of the grey matter for a considerable space. A tubercle also, as large as a hazel-nut, was found in the cerebellum near its superior surface. This case corresponds closely with the vivisectional experiments of MM. Duret and Carville. In an animal the same region of the grey matter was destroyed and paralysis was produced, which lasting only a few days was more complete at one time than another; just as in our patient the destruction of a certain definite portion of the grey cortex produced an incomplete hemiplegia, very variable in intensity and which disappeared at the end of several days, leaving only a weakness in the parts affected. The epileptic attacks at long intervals previous to

the paralysis are equally explicable by vivisectional experiments, for it is well known that irritation of the cortex by electricity will produce not only the contraction of localised groups of muscles, but also more general epileptic attacks affecting as well the whole body as a part. In this case the epileptic attacks were too rare for one to study their type, but the predominance of the convulsions in one part of the body, the point of departure being well determined and always the same, as seen in epileptic hemiplegia, points to lesion of the cortical substance of the brain in its fronto-parietal region. Charcot has proposed to name these varieties Jacksonian epilepsies. Several similar cases to the above will be found in the excellent thesis of Dr. Landouzy, and in a little work by Dr. Grasset, of the medical faculty of Montpellier, entitled 'The Localisation of Cerebral Diseases.'

The recognition of these passing paralytic phenomena as being evidence of a still existing lesion, cannot any longer be ignored by the practitioner as merely theoretical speculations, and experimentalists must be credited with having at least pointed out the existence of a special zone of the surface of the brain, lesions in which entail certain locomotor disturbances, such as convulsions and paralysis.

CHARLES ALDRIDGE, M.D.

Three Cases of Softening of the Brain in the left Hemisphere, affecting the ascending Frontal Convolution or the Anterior Marginal. By Dr. UGO PALMERINI, Siena. *Archivio Italiano per le Malattie Nervose*, Sept. and Nov. 1877.—Dr. Palmerini starts by saying that the two positive acquisitions of late years in cerebral localisation have been the discoveries (1) that language is seated in the frontal lobes, (2) that there are motor centres in the cortex of the cerebrum. He then proceeds to his cases.

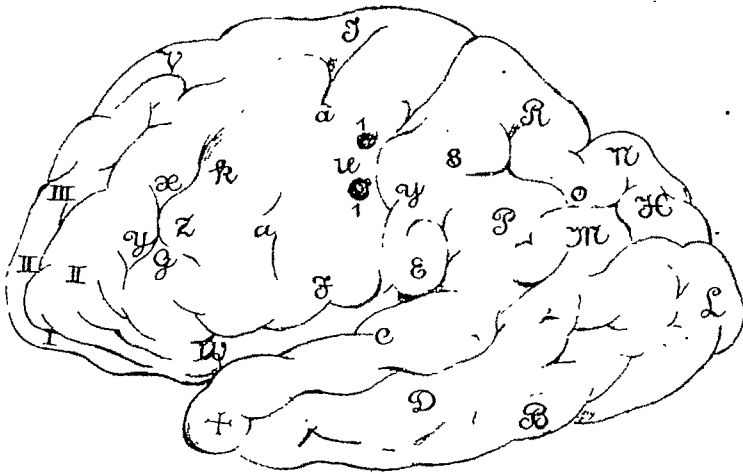
CASE I.

V. G., a tall man, robust, sanguine, with brachiocephalic head and low brow, thin white hair, large shaggy eyebrows, white round protruding eyes, thin cheeks, large red knotty nose, was readmitted into the Asylum at Siena in 1860. He returned in 1861, suffering from mania, with anxiety, depression, taciturnity, intellectual torpor, sighing, sleeplessness, and distaste for food. These symptoms continued for a long time, but gradually declined, so that in 1872 he was discharged cured. He remained quietly at home

Fig.1.

Observation.1.

Case of V.G.



Human brain one third natural size viewed from the left side.
The points at which the lesion of the cortex were seated are shaded.

J. U. F. ascending frontal or marginal anterior convolution.
1.1. Points of the cortex in course of softening.

for over two years; but in 1874, having again become melancholic, he was sent back to the asylum, being then sixty-six years of age. Libidinous symptoms, which were highly developed on the previous occasion, were now again marked. For the rest, his condition was as follows:—Depression, taciturnity, sluggishness of thought and will, affections torpid, and mind deficient. There was no appreciable defect of sensibility or of motion. The heart appeared to be hypertrophied and the aortic valve insufficient. The diagnosis made was progressive dementia, associated with slow atrophy of the brain.

On Oct. 26, 1876, V. G. became suddenly paralysed. His pupils were equal and normally contractile, the angle of the mouth slightly drawn to the left, the tongue unaltered. The right arm was incapable of the slightest voluntary movement. The corresponding leg was paralysed, but not so completely. He could not walk. There was no interference with motor power in any other part of the body, the symptoms gradually passing off without any phenomena of reaction. Dr. Palmerini modified his first opinion, that the case was one of cerebral apoplexy, in favour of the view that it was one of cerebral embolism. The right arm slightly recovered its power, while the patient became able to stand and to take a few steps round his bed about a month after the attack. On Feb. 15, 1877, however, he sank, after having fallen into a state of general atony and marasmus.

Necroscopy. The meninges slightly injected; the dura mater somewhat thickened, and crying under the knife; fine opaque points on the arachnoid, especially along the longitudinal sulcus, and in the fronto-parietal regions. The sub-arachnoid fluid, increased in quantity and filling the spaces left by the change in the convolutions, is collected in little serous pouches.

The Cerebrum. The convolutions of the frontal lobes on both sides appear finer and shallower than usual, while the temporal lobes are well developed and the occipitals are normal. The marginal anterior, or ascending frontal convolution of the left hemisphere, is finer and thinner than the other, and is unmistakably atrophied. In two points of its middle third it appears shrivelled and depressed; when cut with the knife, there appears a softening, which involves the whole thickness of the same convolution, and extends into the central part of the cerebrum, reaching to the centrum ovale of Vieussens, where it dips somewhat into the medullary substance. This zone of softening is about a centimetre and a half in diameter. The rest of the grey substance of the brain appears

attenuated and discoloured. The lateral ventricles are larger than usual. Corpora striata and optic thalami normal. Extensive atheroma of all the arteries of cerebrum. Weight of cerebrum 1178 grammes, cerebellum 140, medulla oblongata 29. Total 1347.

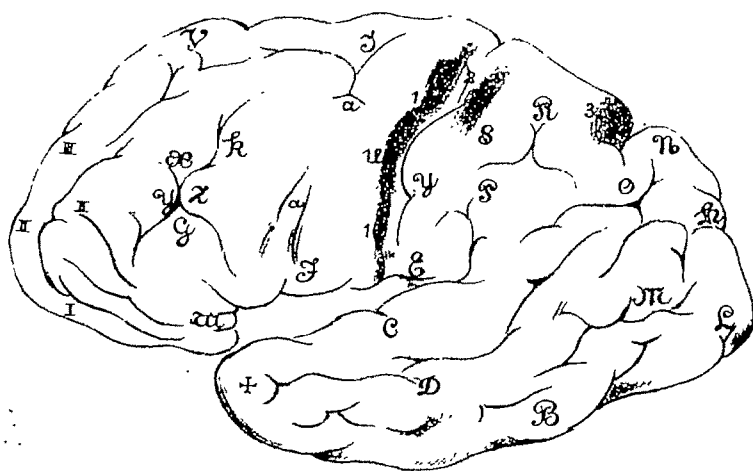
Heart. Hypertrophy of left ventricle. Aortic valves somewhat atheromatous.

A microscopic examination of the brain shows a large quantity of fat granules and cells like drops of oil. Here and there are found numerous deposits of small size lying outside the vessels. The walls of the vessels show granules of fat and of pigment, and the vessels themselves are in some places dilated. The cells of the softened part are scanty. A few are found of normal size, and full of dark yellow granulations. The greater number are either devoid of processes or are rounded, but all are more or less charged with the yellow granules. Even in those parts of the brain which appear normal the cells are more or less charged with fat and pigment. The same is true of the cells of the spinal marrow.

CASE II.

Is that of a young woman, M. M., seventeen years of age when admitted into the asylum of Siena, in 1857. She remained there twenty years till her death. The family history showed no trace of insanity. So far as appears, M. M. had been subject to epilepsy from her earliest infancy, becoming later hemiplegic and imbecile. The idiotcy probably came on gradually, while the hemiplegia is supposed to have been due to a fall in one of her epileptic attacks. In 1877, the year of her death, the following was the appearance of the girl. Low stature, small flattened head, low forehead, animal features, abundance of thick black hair, coming to the middle of the forehead, shaggy eyebrows, and a little hair on the lips and chin; black eyes, equal and normally contractile pupils; good teeth, with which she used to tear her clothes. The angle of the mouth was somewhat inclined to the left side. The right arm was paralysed, the hand powerless, strongly flexed on the forearm and pronated. The forearm, itself capable of very limited movement, flexed on the arm. The arm was capable of some movement backwards and forwards. The right leg was incompletely paralysed. She could walk on the level, dragging her right foot after her; but could not mount steps, or get into bed. Sensibility to pain was unimpaired. She was almost idiotic, having no recol-

Case of M. M.



Human Brain, one third natural size seen from the left side. The diseased points are shaded.

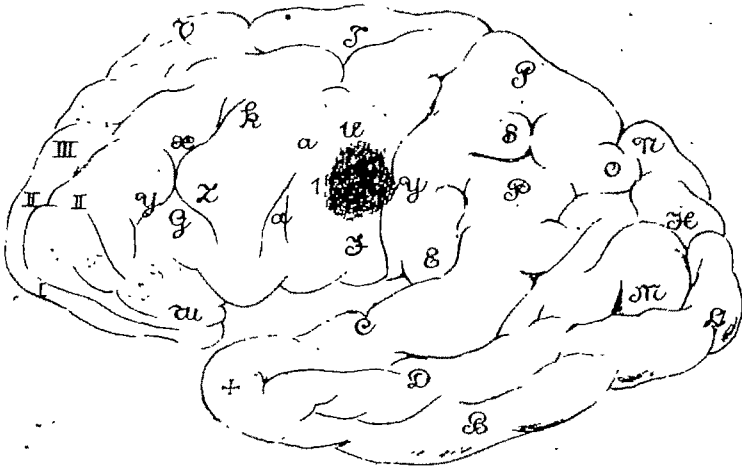
1. A. F. ascending frontal or anterior marginal Convolution, atrophic specially at points 1.1. shaded.

2. Superior part of ascending parietal convolution P. S. S. in course of atrophy.

3. Upper and back part of the Right ascending parietal convolution in course of atrophy.

Fig. 3.

Observation. 3.



Human Brain seen from left side one third natural size.
The grey substance which was the chief seat of softening
as seen in the 3rd observation is shaded.
T. 11. F. ascending frontal or anterior marginal convol-
ution. 1 Seat of softening of grey substance.

lection of home or family, and cared nothing for those about her. She took her food eagerly, and was cleanly in her person. Her vanity was considerable, and she was particularly fond of bright colours in articles of dress. Her powers of language were most rudimentary, ten vocables or so forming her stock of words. She was passionate, and would strike those who knocked against her in passing. In her fits of excitement she would tear and bite her clothes. Successive epileptic convulsions by-and-by reduced her to a state of profound coma. At last she died of a pneumonia so rapid in its nature as to rouse suspicion of pulmonary apoplexy.

Neuroscopy. Cranium brachiocephalic and very small, bones very large. The frontal sinuses very large, and full of bloody serum, had pushed the orbital plates upwards and backwards, so that the frontal lobes did not reach further forwards than the cristagalli. The dura mater was thick, and showed adhesions along the longitudinal sinus. The left hemisphere was much smaller than the right. In both the convolutions were small and depressed; the sulci enlarged, and containing a somewhat turbid fluid as in pouches. The whole brain was atrophied, but the marginal convolution or frontal ascending on the left side was so much atrophied as to be only $1\frac{1}{2}$ millimetre in thickness. A similar but smaller patch of atrophy is found on the corresponding part of the right side. The weight of the right hemisphere was 328 grammes, of the left 243 grammes; total 571. Cerebellum 127 grammes.

On microscopic examination, the brain cells were found smaller than usual, mostly round, some elongated; the greater part devoid of nucleus, shrivelled and full of a finely granular fluid.

CASE III.

A woman, aged fifty, married, of delicate constitution, and lymphatico-nervous temperament, who had suffered from hysterical disturbances, and had been exposed to poverty and excessive toil under a burning sun, had finally to be removed to Siena in the spring of 1876. She remained there till her death in June 1877. Her illness in the asylum divides itself into two periods. In the former she showed a general depression of the feelings and of moral sensibility, with a continual sense of unhappiness; hyperæsthesia over the pit of the stomach; disturbance of the general sensibility, internal and external; and disorders of circulation, indicated, *e.g.*, by blushings, which seemed to point to affection of the vaso-motor system of nerves. The hysterical paroxysms were

replaced by fits of depression, seemingly due to cerebral anæmia, in which she complained of vacancy and confusion of mind. This prior condition existed up to December 1876, when a graver set of phenomena made their appearance. One day she fell into a maniacal paroxysm, accompanied by tremors, violent headache, and anxiety. This passing off, she was left in a state of profound stupidity, in which questions became unintelligible to her; *she could not pronounce words*, nor stand erect, but remained sitting in whatever position she was placed. The blushings continued, along with anxiety about her health. There were marked motor and sensory disturbances. The nature of the dysphasia will be seen from the fact that, on being asked her name, she said she remembered it, but seemed unable to articulate it. When it was suggested to her, she eagerly assented, but even then could pronounce it only imperfectly. Her grief at her condition was acute. There soon appeared some paralysis of the face. The angle of the mouth was drawn to the left, and by-and-by the right arm appeared paralysed, the hand being bent on the forearm, and the forearm on the arm. Attacks of alternate excitement and vacuity succeeded each other till June, when she died. The paralysis of the right arm was more or less marked throughout.

At the necropsy, twenty-five hours after death, the following were noted. Head dolicocephalic; meninges normal on the right side, but on the left hemisphere they were strongly and extensively adherent in the fronto-parietal region. The adhesion comprehended specially the marginal anterior or frontal ascending convolution in all its extent, and could not be removed from the brain substance without tearing the latter. This same adhesion of the membranes to one another and to the brain substance was observed for a space of about two centimetres in the sphenoid lobe. At the adherent points the brain substance was softened. The softening spread inwards as far as the centrum ovale of Vieussens, sparing only the anterior part which constitutes the frontal lobe, and the posterior which constitutes the occipital. In the left sphenoidal lobe the same softening was found. Nothing else of note appeared, except that the left optic thalamus appeared smaller than the right, but both were healthy. The weight of the cerebrum was 890 grammes, of the mesocephalon and cerebellum, 130 grammes.

Before proceeding to formulate the conclusions given below, Dr. Palmerini makes some remarks on the present condition of opinion regarding the localisation of function in the brain. Dupuy, Braun and Burdon-Sanderson think the motor phenomena

due to the propagation of electricity to the nervous fibres of the corpus striatum and bulb. Schiff shows that movements obtained by exciting the brain are not such as are obtained by exciting motor centres, and considers them reflex, and says that the effects of removal of those centres are rather failure of spontaneity—are rather ataxy—than true paralysis. Thus Schiff thinks the points centres of sensibility. Tamburini attempts to conjoin these two opinions, holding the points to be centres at once of motion and of sensibility. Lussana, with whose opinions Albertoni may be associated, entirely negatives the view that the points are motor centres, like those, for instance, of the cerebral peduncles, for these reasons:—

1. In the case of true motor centres any excitation, chemical or mechanical, induces the proper movements. In the cerebral centres electric irritation only has this result.

2. Profound anaesthesia and asphyxia render electric excitation inert in the case of cerebral centres, but not so in true motor centres.

3. Certain dogs, and young animals in general, have no cerebral motor centres, but have the true motor centres.

4. Destruction of a true motor centre is followed by permanent paralysis. That of cerebral centres produces paralysis lasting only from six to eight days.

Lussana, therefore, concludes that the cortical cerebral centres are no other than organs of the will and of the divers instinctive faculties which habitually call into action the true motor centres. In this view our author concurs.

The conclusions which Dr. Palmerini draws from his three cases are the following:—

1. In the frontal ascending or marginal anterior convolution exist *psycho-motor* centres (Albertoni), which exert a manifest influence upon the voluntary movements of entire groups of muscles of the opposite side.

2. These centres correspond in man to the sites indicated by Hitzig, Ferrier, and Albertoni.

3. Lesion of these points produces persistent but incomplete paralysis, susceptible of marked exacerbation and diminution.

4. This particular form of progress of symptoms and the permanence of incomplete paralysis, particularly when preceded by exacerbation and diminution, are two clinical characters of the utmost importance.

5. The constancy of motor lesions, consisting always in phe-

nomena of paralysis and of ataxy, shows that the nature of these centres is motor (psycho-motor) and not sensory.

Case of Abscess of the Brain following Otorrhœa.—In the *Sperimentale* of 1878, Fas. 4, Dr. D. BARDUZZI gives a case of otorrhœa followed by abscess of the brain. It occurred in a boy of nine years old, who had been abandoned by his parents and wandered about in great misery. All the history which could be learned was that, three years before, he had received a severe blow on the ear, which had been followed by the issue of purulent matter, and that a few days before the child had been seized with strong fever, vomiting, and delirium. On admission to the hospital he presented the symptoms of typhoid fever of a cerebral type, intense pain, dry skin, temperature from 39° to 41° C., coma, meteorism of the abdomen, muscular contractions, subsultus tendinum, contracted pupil, dulness of intellect, and slow and confused answers. There was a very scanty secretion of sero-purulent matter from the right ear; but the importance of this as a clue to the diagnosis was overlooked. The boy died forty-eight hours after admission, and it was only on a *post mortem* examination that the nature of the case was cleared up. There was found a diffused congestion of the meninges, and a limited abscess in the posterior lobe of the right side of the brain a little larger than a pigeon's egg. The white substance surrounding the abscess was somewhat softened. There was perforation and thickening of the membrana tympani, caries of the upper wall of the auditory canal, and traces of inflammation in the lateral sinus.

Where suppuration is known to exist in the internal ear, Dr. Barduzzi recommends the employment of drainage, either continuous or repeated, thrice a day, and the use of injections of salicylic acid and chloral.

Alterations in the Condition of the Lungs after Section of the Vagus Nerves. (*Lo Sperimentale*, January, 1878. O. FREY, 'Prize Memoir.')—Frey's conclusions are: 1. Division of both vagi in rabbits, dogs, cats, and guinea-pigs produces pulmonary inflammation and death, which occurs from a true broncho-pneumonia. 2. Persistent constriction of the air-passages by tying of the trachea is not followed in rabbits by any pulmonary inflammation, but only by emphysema (widening of air cells) and atelectasis. 3. Double paralysis of the recurrent laryngeal nerves causes in rabbits pulmonary changes identical with paralysis of both vagi.

In most cases, broncho-pneumonia is developed much more slowly, and is longer of inducing death. 4. Stretching of the accessory nerve and division of the vagus below the recurrent laryngeal has no influence on the lungs or liver. 5. After division of both vagi, if a cannula be inserted in the trachea, no pneumonia ensues, but only a reddening of the lung, which is to be referred to the influence of the cannula, and not to that of the vaso motor nerves which course along the vagus. Yet the animals die, as has been stated by Traube, but after a longer time than without the cannula, and the cause of death cannot be made out. 6. After injection of saliva into the lungs there ensues inflammation equal to that caused by division of both vagi. 7. Division of both superior laryngeals induced in one case pneumonia, in another not. 8. Ligature of the gullet, with division of both recurrents, produces, as Traube first showed, the same pneumonia, and in the same time, as division of both vagi. 9. Paralysis of one vagus and of one recurrent nerve induces similar pneumonia.

A. RABAGLIATI.

Report by Prof. Flemming on the Present Condition of the Therapeutics of Lunacy (Psychiatry), and on Asylums in Germany. (*Archivio Italiano per le Malattie Nervose*. November 1877.)

—Prof. FLEMMING confines himself to the last ten years. After remarking that the improvements in treatment have been very considerable in that period, he refers to the great increase in the numbers of the insane. The increased supply of asylums hardly meets the demand. The increase of lunacy he ascribes to the growing pressure of civilisation, the progress of industry, the *auri insatiabilis fames*, and the increase of nervous diseases in general, with depraved hereditary influences mainly dependent on marriages of consanguinity. A special cause in England and America is said to be the mischievous effects of alcohol. In Germany, every district, every province, and every township, at least possesses one or two asylums. In the last half century eighteen or twenty new asylums have been built, nine in the kingdom of Prussia, and three at least in the Rhine Provinces, while it is contemplated to increase the size of those at Saxenberg and Mecklenburg. In many of these the insane are carefully provided, as far as possible, with the pursuits to which they had been accustomed. Accordingly, we find agricultural ‘colonies’ at Hildesheim in Hanover, at Kolditz, and Hubertsburg in Saxony, and one in contemplation at Mecklenburg and elsewhere. Lunacy being on the increase as well in the

higher classes, private asylums have become much more numerous in the same period.

As to treatment two methods are detailed. The first consists in the complete abolition of coercive remedies. With the discussion of this method English readers are perfectly familiar through the works of Tuke, Conolly, and others. The second is described as the narcotic method (*metodo di stordimento: Betäubungsmethode*). Narcotics are used such as hyoscyamus (Greding), small doses opium (Enquelhen de Brennen), hypodermic injection of morphia (Wood), very small doses of atropine alone or in combination with opium. Allied to these are such remedies as chloroform, bromide of potassium, which diminishes cerebral congestions, and hydrate of chloral. Attention is specially directed to the hypnoticum of Prof. Preyer of Jena, which is a lactate of soda, and acts as a calmative, Preyer believing that the accumulation of lactic acid in the brain is the cause of normal sleep. This remedy is administered in doses of five to sixteen grammes by the mouth or rectum. This remedy, however, is still on its trial.¹

Prof. Flemming has a high opinion of the value to the science of psychiatry in Germany of the frequent congresses of medical men engaged in this branch. The first of these was held in Kiel, at the suggestion of Prof. Jessen, and has become a yearly institution. The paper closes with a notice of the German periodicals devoted to this branch of science, and with a sketch of the arrangements made by the universities for its inclusion in the clinical course. It is stated that the German Empire with a population of forty millions, contains eighty-seven public asylums, with 20,700 patients, and 107 private asylums, containing 5,000 patients. These establishments are attended by 325 medical men. Twenty-six establishments are devoted to the care and instruction of idiot children.

A. RABAGLIATI.

Hemianæsthesia. F. MÜLLER, Graz. (*Berl. Klin. Wochenschr.* 1878, No. 20.)—This paper contains a very carefully described case of hemianæsthesia. The patient was a man, aged 61, suffering from chronic alcoholism and aortic insufficiency. About seven weeks before admission into hospital, he complained of headache, constantly increasing in severity, and of feelings of numbness, tingling, and creeping in his right arm. In a few days these

¹ This remedy has proved of only small and doubtful utility in my hands.

symptoms were succeeded by an apoplectic seizure, with right hemiplegia and loss of speech. Speech was regained in eight days, and in fourteen days the patient was so far recovered that he could leave his room and attend to his business; he only felt a weakness in the hand and foot of the right side. He was admitted into hospital, complaining of headache and cough.

An examination of the nervous system revealed slight right hemiparesis; the movements on this side were somewhat weak, but were regular and well co-ordinated; on walking with the eyes closed there was no evidence of ataxia. There was complete right hemianæsthesia. The patient was not aware of the loss of sensation, and was quite surprised at experiencing no pain on being pricked with a pin. The hemianæsthesia was strictly limited by the median line. The bones had lost their sensibility. Pressure over the liver was slightly felt. Tickling and pinching of the upper and lower extremities were followed by reflex movements; tickling of the right external auditory meatus was without effect. The conjunctiva and cornea, and the mucous membranes of the cheek, tongue, soft palate, uvula, nostril, glans penis and anus were quite anæsthetic. There was a total loss of the muscular sense on the right side. Patient could not distinguish between objects of different weight; he was ignorant of the position of his limbs at any moment; and if told to move a limb, the movement being forcibly prevented, he would make an effort for a time and then cease, thinking the movement had been accomplished. The sense of temperature was lost on the right side. There was almost complete amblyopia of the right eye; the ophthalmoscope revealed nothing in the fundus that would account for this. The left eye was quite normal, and showed no trace of hemiopia. Hearing was so far affected on the right side that the ticking of a watch was only heard when the watch was in contact with the ear; on the left side it was heard with the watch at a distance of 50 cm. Smell was completely lost on the right side, and taste was greatly impaired over the whole right half of the tongue. The organs of sense on the left side were quite normal. Examination with the faradaic current showed complete loss of electro-cutaneous and electro-muscular sensibility; the minimal strength of current requisite to produce contraction was the same on both sides. The opening and closing shocks of a Stöhrer's continuous current battery of 30 cells caused very powerful contractions, but no pain. On applying the negative pole to the upper eyelid (the lids being closed); and the positive pole to the cervical vertebrae, the optical appearances

known as Purkinje's figures were produced on opening and closing the current—in the right eye with 6 cells, Stöhrer, in the left eye with as few as 2 cells. On stimulating the right border of the tongue, there were muscular contractions, but no metallic taste.

There is little to note in the further course of the case; the hemiparesis almost disappeared, the hemianæsthesia remained as marked as ever. The patient died three weeks after admission, of infarction of the right lung. On *post mortem* examination, a very sharply circumscribed focus of softening, of the size of a pea, was found involving the apex of the third division (posterior point of external segment) of the lenticular nucleus and the adjacent white matter. Very careful examination failed to discover any other lesion.

In discussing the case, the author quotes Pierret's statement that the hinder part of the internal capsule or the adjoining part of the corona radiata was found affected in thirteen out of the fifteen cases of hemianæsthesia in which an autopsy had been made. He further points out that the view here taken of the pathology of hemianæsthesia is in harmony with results arrived at by physiologists and anatomists, for Veyssière has shown by his experiments on dogs that hemianæsthesia is very specially associated with lesion of the hinder and upper part of the internal capsule; and Meynert has described in the same part of the capsule a bundle of sensory fibres proceeding from the occipital and temporal lobes directly downwards to the crus. The author attributes the hemiparesis to the implication of the lenticular nucleus. Lastly, he recognises the complete identity of the symptomatology of hysterical hemianæsthesia and of hemianæsthesia produced by foci of hæmorrhage or softening, the former being due to a functional, the latter to an affection of the posterior part of the internal capsule.

W. J. DODDS, M.B., D.Sc. (Edin.).

Pathological Lesions versus Motor Centres.—Dr. Maragliano has a paper in the *Rivista Sperimentale di Freniatria* (Anno IV. Fascicolo i.), on the localisation of motor functions in the cortex cerebri, studied from the clinical side. He considers that the views of Hitzig and Ferrier are substantially the same, as they agree in the relative position of the motor centres. He has collected ninety-seven cases of cerebral lesions, with a view to observe the correspondence of the symptoms during life with the parts of the brain injured. These cases are collected from French, English,

German, and Italian sources. He finds that they agree in a wonderful manner, especially with the observations of Ferrier, who gives greater extension than Hitzig to the portion of the cortex excitable to electricity.

Charcot and Pitres, basing their deductions on a smaller number of observations—forty-one in number—concluded that derangement of the movements of the superior extremity corresponded with a lesion of the middle third of the ascending frontal gyrus (gyrus centralis anterior). But Dr. Maragliano thinks that we cannot thus limit the motor centre of the arms which must cover the two upper thirds of the entire motor zone, for he finds paralysis and convulsions confined to the arms corresponding with lesions disseminated over this whole tract. He, however, agrees with Bourdon, who has made a collection of twenty cases, among which are paralysis or arrested development of a single limb, and amputations corresponding with atrophy of the cerebral cortex.

A continuation of the paper is promised, and in the meantime Dr. Maragliano gives the following conclusions:—

1. That alterations in the cortex of the cerebrum may cause alterations in the motor functions of the body.

2. That this influence upon the motor functions of the body comes exclusively from the frontal and parietal lobes.

3. That lesions of the frontal convolutions are more frequent than those of the parietal.

4. That in the frontal lobe the faculty of influencing the motor functions is confined to the ascending (gyrus centralis anterior) frontal, and to the posterior part of the first, second, and third frontal.

5. That of all the frontal convolutions the ascending gyrus is oftenest injured.

6. That in the parietal lobe the faculty of influencing the motor functions resides especially in the ascending parietal (gyrus centralis posterior).

7. And that lesions are found in the two ascending or median gyri in equal proportions.

8. That in the motor derangements confined to the upper extremity the lesion may be found in the two upper thirds of the motor zone.

9. That the motor derangements of both the limbs correspond to lesions in the two upper thirds of the two ascending or median gyri.

10. That when pronounced disturbances of the muscles of the eye are associated with motor derangements of one or both limbs, we constantly find a lesion in the inferior third of the ascending frontal gyrus.

11. That motor derangements of the superior palpebral muscle seem to correspond with lesions of the inferior parietal gyrus.

12. That the phenomena of excitation, cramps, convulsions, and other epileptiform attacks, correspond indistinctly to alterations in the ascending frontal and parietal convolutions, and to points immediately contiguous.

The Influence of Magnets upon Anæsthesia.—Drs. Magliano and Seppilli (*Rivista Sperimentale di Freniatria*, Anno IV. Fascicolo i.) have made some investigations with a view to test the observations of Gellé, Landolt, and Charcot as to the influence of electrical currents and magnets upon anæsthesia. These observers have made the extraordinary statement that they were able to remove, by the application of magnets and metallic plates, the loss of hearing, of sight, and of general sensibility, and that in some cases of hysteria and chorea the loss of sensory power was shifted over to the corresponding spot on the previously sound side.

These experiments were repeated on three patients—two women affected with hysterical-epilepsy, and one man who became hemiplegic after a fall.

They have arrived at the following conclusions:—

1. In anæsthesia on one side, the application of the electric currents, or of metallic plates, or of a magnet, causes not only the return of general sensibility, but also that of special sense.

2. In anæsthesia of one side, of cerebral and organic origin, returning sensibility brought back by these various means extends not only to the zone of application, but also to the whole half of the anæsthetic body.

3. In hysteria, the return of the sensibility of the anæsthetic side coincides with the disappearance of anæsthesia on the sound side, and that in a zone perfectly symmetrical.

4. The duration of returning sensibility is more persistent in cases of organic anæsthesia than in that of functional anæsthesia.

5. Probably the different means that determine such effects all act through electric currents, which in their turn act either on the vaso-motor fibres, or more especially on the sensitive fibres.

6. The south pole of the magnet seems to have a greater action than the other pole.

7. Ovarian hyperæsthesia can disappear under the influence of the magnet.

The Pulsations of the Brain.—Dr. Carlo Giacomini gives in a pamphlet of forty pages¹ an account of a patient who had contracted syphilis from her husband. She had repeated attacks of inflammation in the bones of the skull and gummatous tumours, and several times recovered through the use of iodide of potassium. At last she took syphilitic osteitis, which destroyed a large portion of the table of the skull. She also lost the vomer and a portion of the palate. The overlying integuments of the scalp sloughed away, along with the portions of the skull lying under them. At the posterior part of the left frontal bone the dura mater was exposed to the extent of a five-franc piece, and the contraction of the cranial space after cicatrization was calculated to be equal to the loss of 150 cc. of the brain-substance.

The author determined, along with Dr. Mosso, to make a special study of the motions of the brain, as observed through the dura mater. This was done by the help of Marey's cardiograph, the button of which was adjusted upon the centre of the part that was laid bare, the curves reproduced, as traced upon a piece of smoked paper, indicating by their zigzags the rising and lowering of the brain. The first comes during the systole of the heart, and indicates the wave of blood driven into the brain, distending all its vessels so as to produce an increase in the volume of the hemispheres. The descending curve coincides with the diastole of the heart when the vessels become emptied of blood, and the organ diminishes in volume.

The curves are not always equal, one out of every three or four of the cerebral pulsations rising higher than the other; this depends upon the respiration. At every inspiration the blood flows more freely from the vessels of the brain, and at this time the curve descends lowest. During the expiration the blood meets a greater difficulty in returning from the brain, hence an elevation in the curve of the cerebral pulsations.

By means of a rotatory cylinder applied to the chest to indicate the movements of the thorax, they were able to make out the exact correspondence of the expiration with the highest part of the cerebral curve, and that of inspiration with its descent. A great

¹ 'Sifilide Ossea: Esportazione di gran parte delle ossa del Cranio e della Faceia; Comunicazione fatta alla reale Accademia di Medicina di Torino dal Socio Dott. Carlo Giacomini,' &c.

increase of the pulsations appeared after compression of the jugular veins, and during deep sleep obtained by chloral. Under these conditions the pulsations were twice or thrice the size usual. There were also irregular undulations in the curves, which could not be explained in a satisfactory manner. On compression of the carotids the cerebral pulsations ceased, so that instead of a zigzag a straight line was left on the smoked card; but in a little time the pulsation returned, evidently owing to the blood supply finding its way into the vessels from the basilar artery through the circle of Willis. On compression of the jugulars the volume of the brain increased rapidly, and as rapidly descended on the pressure being withdrawn.

These observations, which were repeated during several months, are of indisputable value; but it is singular that the author never once remarks that the natural condition of the brain, save in infants, is different from what it was in the case studied, where there was an open wound exposing the organ to the pressure of the atmosphere.

The same number of the *Rivista Sperimentale di Freniatria* contains a valuable paper by Drs. Luciani and Tamburini, which details a part of their experiments on the functions of the brain made upon guinea-pigs, cats, dogs, rabbits, and apes, by the application of electricity to the denuded surface of the brain. As the paper is not finished, and the conclusions deduced from the experiments are still to come, it may be as well to defer giving a *résumé* of these laborious researches till the sequel is published.

W. W. IRELAND, M.D.

B R A I N.

JANUARY, 1879.

Original Articles.

EXPERIMENTAL RESEARCHES ON ATTENTION.

BY DR. H. OBERSTEINER.

Privat-Dozent in the University of Vienna.

THOUGH my chief object in this paper is to describe the results of some experiments which I have made in reference to the faculty of attention, both in the sane and insane, I would, before entering on a description of my experimental researches, make some preliminary remarks on what I mean by attention (*Aufmerksamkeit*).

It is unquestionable that during the last decade we have made great advances in our knowledge of the conditions of the higher psychical manifestations. We know that there are certain parts of the central nervous system which are the substrata of these phenomena. The progress of the physics and chemistry of organic life, *i.e.* physiology, has thrown new light, especially on nerve life; and we may conclude from the analogy of their structure, that the cells and fibres of the cortex of the brain are subject to the same laws as rule the nervous system in general. In our explanation of psychical phenomena, however, we must come at last to a point beyond which physical and chemical principles and methods cannot carry us. Here where physics end, "mind" begins.

It is to be remembered, however, that, as in our explanation of vital phenomena, we do not now in the present state of physiology consider it necessary to postulate the existence of a self-sufficient intelligent principle called Vitality (a principle which has ever retreated before advancing scientific research), so we need not in cerebral physiology assume the existence of a psychical principle, to be called in only like a *deus ex machina*, to fill up the lacunæ of our imperfect knowledge. Do we know more of the nature of the segmentation of the ovum after the entrance of the spermatozoon through the micropyle, than we do of the sensation of light which results from the entry of a ray of light through the pupil? It would be easy to show, though it would lead us too far, that even in the phenomena of the inorganic world there are limits which we cannot as yet pass, and which will still be found the farther we go. We need not therefore shrink from an analysis of psychical phenomena, and even if we do not succeed in completely elucidating them, yet we may approach nearer to a knowledge of the conditions of their manifestation.

The general sum of all the ideas (*Vorstellungen*) of which we are capable constitutes the "ego," but of all these more or less numerous ideas, there is only one which in each moment of time can be completely clear in consciousness. I am strongly of opinion that we never can have two ideas equally vividly before consciousness at the same moment. This one idea may perhaps be separable into further individual elements. So soon, however, as we commence the analysis, each individual factor only of this complex whole can be clearly in consciousness at any one moment. A musical harmony may be perceived as a whole, but we can analyse this into individual tones. When we do this, however, the other notes fade, and we hear them faintly only, or not at all. Even the fact of binocular vision, which is urged as an argument against the unity of consciousness, has no real force. Images are certainly formed in both eyes, but they are fused together in the brain so as to form a single stereoscopic image, without our being conscious of the separate impressions on the right and left retina respectively.

If, then, only one single idea can predominate at a given

moment, we have further to acquire *which* will be the predominant one. In order to answer this, we must know the motive which causes the idea to rise before consciousness. The conscious activity of our brain manifests itself in three modes, and we must consider the question in accordance with this triple mode of manifestation. These are (1) Perception, Sensation; (2) Volition, Action; (3) Reflection, Meditation.

In each of these three spheres, the current of ideation (*Vorstellungsverlauf*), or order in which ideas present themselves in consciousness, will be influenced by three factors. Of these the first two act as *stimulant* (like the accelerator nerves of the heart), the other as *inhibitory* (like the inhibitory nerve of the heart). The factors causing stimulation or irritation are (1) external stimuli; (2) internal, either direct or called up by association. The inhibitory influence, that which we have specially to consider, is that of attention.

Let us take the simplest case of a sensory perception. Every sensory stimulus affects us as motion—light, as undulations of the ether; sound, as vibrations of the air, &c. In the peripheral organs of sense, this motion which represents a certain amount of energy is converted into another form of motion, that of nerve energy; and in this manner, through the special sensory nerves, a corresponding amount of force acts upon the brain. Of two tones, other conditions being equal, that which exerts the greater force on the brain will be heard the more clearly, be more vivid in consciousness. We have here the first factor of the predominance of a given idea, or presentation of sound. There may, however, be conditions under which the weaker tone will predominate over the stronger. For instance, let us suppose that the former is peculiarly sharp and unpleasant, then to the tone-sensation is added the feeling of discomfort, and so the weaker impression becomes reinforced and prevails over the louder. Or if among various louder voices there should be a weaker, which, however, recalls the image of a dear friend, then the louder voices cease for the instant, and we hear above all the weaker voice of our friend. Here we have the internal excitants of a mental presentation; in the one a sensation acting directly, in the other an idea acting indirectly by association.

We have, however, the power, independently of the intensity of the stimulus, and without reference to the feeling, of selecting from several simultaneous impressions a single one, and concentrating our consciousness on it. This we can only do by inhibiting all other simultaneous impressions. While in the first illustration, that of two sensations appealing to consciousness, it was a question either of the intensity of the impressions or the accompanying feelings, here we have to deal with a higher process, an act of volition. We purposely turn our attention to a certain impression which we have selected and chosen, as in the case of the several tones of a musical harmony alluded to above. Another experiment which clearly illustrates the faculty of inhibition is the following. Suppose we are in a room in which there are three clocks going not quite synchronously, and all within earshot. We first hear the clock in which the pendulum action is loudest in our ear. When we begin to count its beats, that is, direct our attention to it, the other two clocks become to us altogether silent. Now, if we wish to count the beats of the second or third, it is necessary to repress the consciousness of the beats of the first, which has hitherto mainly attracted our notice. To do this, however, often takes a distinct interval, and not unfrequently it requires some effort to get rid of the sound of the first clock.

And as in the domain of sensation, so in that of action, we can exercise this inhibitory influence. Our actions are conditioned first by sensory perceptions, further through feelings associated with them, and also by revived sensory and motor ideas. We can, however, *will* that a certain action to which there exists a powerful stimulus should be repressed, and carry out another. By inhibition of the former we concentrate our attention on the latter. How difficult it is to repress the motor manifestation of a painful sensation is a matter of everyday observation. Still it is possible, and another action can be substituted for it.

Looking lastly at the conditions of reflection or meditation, we observe a power of arranging and ordering the course of ideation.

Ideas tend to call up other ideas by association, and natu-

rally along the most easy channels. But we can check the current of ideation along the easiest paths, and divert it into paths which are more difficult. We think attentively, and inhibit continuously. The more powerful this inhibitory working of the attention, the more intense the thought, the more numerous the paths opened up, and the more productive in its consequences. Just as a ball placed on a slope will roll straight down unless sufficient force is exerted to turn it aside, so our ideas tend to take the easiest path of association unless we direct them by the exercise of our volition, the power of attention.

It appears, therefore, from these considerations, that in every mental act, whether it be in the domain of sensation, volition, or intellect, there is seen an inhibitory power, essentially the same in all cases. This inhibitory power, on which depends all consecutive mental action, is Attention.

Starting, then, with the fact that in perception, thinking, and action the same inhibitory faculty is in action, we may endeavour to analyse complex psychical processes, in which one of the three factors—attention—may be regarded as a constant. It will be of interest to ascertain the conditions by which attention is liable to be influenced, whether in normal or abnormal states of mind. To do this, it is necessary to adopt a method by which mental processes can be excited in a simple, rapid, and uniform manner. A certain period of time is necessarily occupied corresponding to the rate of transmission in nerves. If we assume that the rate of transmission in peripheral nerves, and probably also in the central nerve-fibres, is tolerably uniform in different individuals, and liable to variation only by few conditions, such as temperature, this by no means holds in reference to the rapidity of transmission through the nerve-cells. I have shown¹ that in the secondary forms of insanity, in which therefore an organic change in the cortical nerve-cells may be assumed, a distinct retardation of psychical processes may be demonstrated. Exner and I have also shown this in the case of individuals of advanced age.

By multiplying experiments we may determine in each

¹ 'Ueber eine neue einfache Methode zur Bestimmung der psychischen Leistungsfähigkeit des Gehirnes Geisteskranker': Virchow's 'Archiv,' Bd. lix.

individual the time necessary for a given mental process, allowance of course being made for practice. Having determined this, we are then in a position to separate the cases in which a distinctly longer period is required for the given process. In these circumstances the excitation does not travel, as formerly, in a direct path to the ultimate manifestation, but is allowed to diffuse itself. The individual is not on the alert, his attention is feeble. In the following experiments we seek to determine the minimum period necessary for a given psychological act in different persons, and next to ascertain under what conditions a distinct retardation is observed. This retardation stands in inverse proportion to the intensity of attention. In these experiments I have made use of an apparatus devised by Exner and myself, called the Psychodometer, the construction of which I have described in my above-mentioned paper. In the employment of this instrument the subject of experiment has to indicate by a movement of his finger the exact moment at which he perceives a sound emitted by the apparatus. The instrument is capable of registration of intervals of time up to 0.001 second.

A portion of the interval of reaction is occupied by the transmission through peripheral nerves, also through part of the spinal cord, and also by the latent period of sensory and muscular stimulation. All these factors may be practically regarded as constants, except under certain conditions, such as diseases of the spinal cord, and circumstances affecting the transmission in the peripheral nerves. The chief portion of the whole reaction-period belongs to the condition of the cerebrum. Great variations are here observable. These variations may, without great error, be read off directly from the differences of the whole reaction-period. The result is that these differences in the reaction-period which may serve directly as the measure of attention vary in different individuals, and in the same individual under different conditions.

I will first briefly allude to those differences which have been observed in a large number of different individuals, leaving out cases of mental derangement. It has been found that the degree of attention varies chiefly with the degree of culture, to some extent also with age and sex.

An accomplished and practised scientific observer, capable of turning his attention in a multiplicity of directions, seldom exceeds the minimum by more than 0.04 second. Thus, as the result of a long-continued investigation, Dr. P. gave a minimum reaction-period of 0.117 sec., and a maximum (certain complications excluded) of 0.157 sec. The mean, 0.129, transcended the minimum only by 0.012 sec.

When these results are compared with those of similar experiments on the serving class, a marked difference is manifest. One of these may react as rapidly as one of the educated class, but as a rule the reaction-period is distinctly above the minimum. One example may be quoted. My servant gave a minimum of 0.125 sec., but varied greatly between this and the maximum of 0.183 sec.; so that the mean of twenty-five experiments gave a reaction-period of 0.151 sec.

Persons of advanced age, as has been said, react more slowly, a fact, however, depending more on the less rapid functional activity of the nerve-cells than on the degree of attention. Still the latter is commonly diminished also, as the great variations in the reaction-period indicate.

As regards sex, it may be stated that there does not appear to be any direct relation, in and by itself, between this and the degree or power of attention. On the other hand, however, the occupation and the mode of life of the male, which commonly demand more continued attention, and lead to corresponding development of his inhibitory faculty, show themselves in this, that the smallest differences in the several reaction-periods are met with in him—a proof of actively developed attention.

We may now inquire in what way in the same individual attention may be affected by external influences. It may be stated in general that all other ideas or presentations which obtrude themselves tend to divert our attention for a longer or shorter period from the object which is the basis of the experiment.

I will first give the reaction values which I obtained in the case of Mrs. P. under normal conditions—quoting only a very small portion of the experimental series.

TABLE I.

Sec.	Difference.	
0·128		} Mean = 0·133 sec.
0·116	- 12	
0·122	+ 6	
0·150	+ 28	
0·135	- 15	
0·145	+ 10	

In a second series, in which the same individual was sleepy and tired, the results were:

TABLE II.

Sec.	Difference.	Sec.	Difference.
0·189		0·186	- 14
0·166	- 23	0·198	+ 12
0·200	+ 34	0·159	- 39

The reaction-period appears markedly prolonged (0·159 sec. being the *minimum* of six observations). This is easily accounted for by the fatigued condition of the cerebral cells. At the same time, also, the variation in the several reaction-periods were much greater than in the first series, an indication of the diminished power of attention. In a third series of experiments on the same person, when suffering from headache, the following results were obtained.

TABLE III.

Sec.	Difference.	
0·174		} Mean = ·171.
0·128	- 46	
0·176	+ 48	
0·250	+ 74	
0·123	- 127	
0·190	+ 67	
0·146	- 44	

Here the shortest period, 0·123 sec. differs greatly from the minimum period under normal conditions, 0·116 sec., and the difference between the several periods is also much greater—up to 0·127 sec.

The existence of a severe headache, therefore, greatly interfered with the concentration of attention.

I have made a series of experiments with a view to determine the influence of various external sensory impressions on the psychical process, and have found that every other sensory

impression, of whatever nature, in the first instance at least, invariably diverts the attention and prolongs the reaction period. My friend, Dr. Gelpke, who has kindly submitted with much patience to be experimented on, is one of the quickly reacting individuals. The following table gives the values obtained in his case.

TABLE IV.

Sec.	Difference.	
0·108		} Mean = 0·100 sec.
0·119	+ 11	
0·114	- 5	
0·087	- 27	
0·104	+ 17	
0·092	- 12	
0·095	+ 8	
0·087	- 7	
0·084	- 3	
0·119	+ 16	
0·115	+ 15	
0·085	- 30	
0·100	+ 15	
0·109	+ 9	

These values, obtained under absolutely normal conditions, and in the absence of disturbing influences, will serve as a standard of comparison with the following.

I placed a musical box which played softly in his vicinity, and in several of the experiments, marked by a *, I interrupted the music.

TABLE V.

Sec.	Difference.	Sec.	Difference.
0·148		0·121	- 8
0·141	- 7	0·140	+ 19
0·120	- 21	0·133	- 7
*0·095	- 25	*0·087	- 46
0·215	+ 120	0·144	+ 57
0·124	- 89	*0·108	- 36
0·129	+ 5	*0·091	- 17

Dr. Gelpke's mean reaction-period being 0·100 sec., and his minimum 0·084 sec., it is seen first, that, so long as the music continued, he reacted much more slowly, and that there were marked individual variations. When, however, the disturbing element, the music, ceased, the reaction-period sank every time to within the normal values (compare the four

elements marked by a *). Similar results were obtained in a series of experiments, during which the experimentee looked into a kaleidoscope with changing figures. Those experiments, during which the eyes were shut, are again marked by a *.

TABLE VI.

Sec.	Difference.	Sec.	Difference.
0.125	.	*0.099	- 62
0.141	+ 16	0.146	+ 47
0.200	+ 59	0.126	- 20
0.159	- 41	0.203	+ 77
0.210	+ 51	0.187	- 16
0.210	0	*0.085	- 102
0.148	- 62	*0.096	+ 11
0.161	+ 18	0.127	+ 31

The analogy of this with the former table is so striking as not to require further mention.

The same holds in Table VII., in which while Dr. Gelpke worked the psychodometer with his right hand, I applied a tolerably strong induction current to the left arm, occasionally interrupting the stimulation as indicated by a *. The first two observations marked ** were made before beginning the cutaneous irritation.

TABLE VII.

Sec.	Difference.	Sec.	Difference.
**0.104		0.182	- 16
**0.090	- 14	*0.122	- 60
0.220	+ 130	*0.127	+ 5
0.120	- 100	0.175	+ 48
0.187	+ 67	0.145	- 30
0.198	+ 11		

The two observations (*) made without irritation can scarcely be regarded as altogether free from complication, as the Neef's hammer of the induction machine continued to vibrate, even when the electrodes were not being applied. An auditory, or optical, as well as a cutaneous stimulus has the effect of prolonging the reaction-period. It should be specially mentioned that Dr. Gelpke always endeavoured to abstract from the disturbing influences and concentrate his attention on the reaction. Nevertheless the retardation was always not only evident, but frequently very marked. The influence of fatigue and certain uncomfortable sensations (headache) as shown in

Tables II. and III., is identical with those indicated by Tables V.-VII., that also the frame of mind influences the attention, and therefore the reaction-period, as shown by the researches of Dietl and Vintschgau.¹ These observers found that the reaction period was distinctly prolonged by emotional feeling. Though they are of opinion that attention is not thereby diminished, this depends on the meaning they attach to attention. At any rate they give no other sufficient explanation of this retardation of reaction.

We have thus become acquainted with a series of influences which cause variations in the course of a simple psychical process which we can attribute to a diversion of attention, and it has been possible to measure the amount of this diversion by the degree of retardation of the reaction. I will not here enter on the question as to the influence of certain drugs and articles of food on the power of attention, but proceed to consider the influence of certain abnormal conditions of the nerve centres on this faculty. I have made numerous experiments on the insane, the results of which I have in part described at length in my former paper. In reference to the question immediately before us, the chief results of these and subsequent experiments may be stated in a few words. Naturally there are cases unfitted for investigation, but the simplicity of the apparatus and the ease of manipulation render it possible to make observations in a very large number of cases of insanity. Experiments showed that in the great majority of such cases there was a more or less distinct retardation of the reaction-period, exhibited either in increase both of the mean and the minimum value, or in distinct increase of the mean value, while the minimum did not exceed the normal limits. Increase of the minimum period always corresponded with grave organic degeneration of the brain. It was seldom found in the primary forms of insanity, but particularly so in dementia and general paralysis of the insane. Those cases, on the other hand, which did not show increase of the minimum period, but great differences in the results of individual observations, were such as were incapable of concentrating their attention, owing to reasons presently to be mentioned. • The first class of cases are

¹ Pfäuger's 'Archiv,' Bd. xvi.

to be compared with the observations in Table II.; the second class with those of Tables V., VI., VII.

The following table gives the results of some experiments on the first class of patients.

TABLE VIII.

Sec.	Difference.	
0.179		} Mean 0.166 sec.
0.177	- 2	
0.165	- 12	
0.152	- 18	
0.198	+ 46	
0.178	- 20	
0.188	+ 10	
0.155	- 38	
0.144	- 11	
0.164	+ 20	
0.167	+ 3	

These values were obtained in the case of a patient in the incipient stage of general paralysis. The minimum is 0.144 sec., which, though not greatly, is distinctly above the normal. At the same time, however, there are great individual variations, so that the mean reaches 0.166 sec. In the two following tables are exhibited the reaction-periods in two cases of general paralysis, in the first of which the disease was not far advanced, but more than in the former case; while in the second (Table X.) the disease had advanced to a state only just compatible with experimental investigation.

TABLE IX.

Sec.	Difference.	
0.404		} Mean 0.281 sec.
0.260	- 136	
0.207	- 53	
0.180	- 27	
0.216	+ 36	
0.275	+ 59	
0.198	- 77	
0.208	+ 10	
0.520	+ 312	
0.347	- 173	

TABLE X.

Sec.	Sec.
—	0.303
—	0.402
0.390	0.755
—	—
—	• 0.224

The shortest period in Table IX. was 0·180 sec., while in Table X. it amounted to 0·303 sec. The dashes in Table X. (—) indicate those observations in which the patient made no reaction at all.

I now pass to those forms of mental derangement in which there is no direct degeneration of the cerebral cells, in which, therefore, the psychical processes proceed with equal rapidity as in the normal state. These cases are of greater interest in our inquiry, inasmuch as we have to deal with elements which are still capable of performing their functions, being free from organic degeneration. One series need only be quoted, as it is a type of all the others which I have carried out.

TABLE XL

Sec.	Difference.	
0·260		} Mean 0·199 sec.
0·135	— 125	
0·254	+ 119	
0·115	— 139	
0·153	+ 38	
0·340	+ 187	
0·237	— 103	
0·165	— 72	
0·140	— 25	
0·193	+ 53	

These values were obtained in the case of a young man full of self-conceit, and ever engaged in contriving great plans and speculations. He had also many hallucinations, but he has since completely recovered. In this case the minimum was small, viz. 0·115 sec., and distinctly within the normal. On the other hand, the reaction-period in some instances was greatly increased (up to 0·340 sec.), and the individual differences are great, giving a mean of 0·199 sec., which is 0·089 sec. higher than the minimum.

In this case the functional activity of the brain was not impaired as regards rapidity, but the ideas and hallucinations to which the patient was subject frequently disturbed his attention and prolonged the reaction-period.

It appears, therefore, that in most cases of mental derangement there is an impairment of the faculty of attention, which we can state in exact measurements. Taking a general review

of these facts, we see that it is possible to analyse psychical processes into their factors, and subject them to a method of investigation which enables us to give a quantitative estimation of their intensity. Without unduly occupying space, I will only say that I have varied these experiments in many ways, but all have pointed in the same direction.

In conclusion, let me say a few words on the views entertained by physiologists in recent years regarding attention. It may be affirmed that a scientific consideration of this subject is, until very recently, rarely to be found in treatises on physiology or psychology. Yet this subject had already in the year 1822 been carefully investigated by the founder of a psychology based on scientific and mathematical principles, viz. Herbart. In his treatise '*De Attentionis Mensura*' (Königsberg, 1822); and later, in his chief work '*Psychologie als Wissenschaft, neugegründet auf Erfahrung, Metaphysik und Mathematik*,' II. Th. (Königsberg, 1824-5), §§ 95 and 128, Herbart put forward the view that attention consisted in inhibition of ideation. That an inhibition of certain ideas was a distinct psychical process was also held by Kant, but he distinguishes between this, which he terms abstraction, and attention. He says, "the effort to call ideas into consciousness is either attention (*attentio*), or abstraction from an idea of which I am conscious (*abstractio*). This latter is not merely a cessation and omission of the former—this would be absent-mindedness (*Zerstreuung*)—but a real mental act" ('*Anthropologie*,' p. 14). In later times the correspondence between an act of will and an act of attention was recognised by Sir. W. Hamilton ('*Lectures on Metaphysics*'), and by Laycock ('*Mind and Brain*'). In a short memoir which I wrote on Sleep ('*Allgem. Zeitsch. für Psychiatrie*,' 1872), I specially considered this inhibitory factor in volition and attention, and also in reflection or the higher intellectual operations.

The various modes of inhibition have been clearly and ably discussed by Lauder Brunton ('*West Riding Asylum Reports*,' vol. iv.). Exner has submitted the simplest psychical processes to a thorough experimental investigation (Pflüger's '*Archiv*,' Bd. xi.; III. Abtheil.) Of the faculty of Attention, he says, "When we attend to sensory impressions, something occurs in

the sensorium whereby it is rendered duller to all other impressions, and as if the centres engaged were rendered more excitable at the expense of the others." More recently Ferrier in his work on "The Functions of the Brain," has thoroughly discussed the subject of Attention, and arrived at the following conclusion:—"The centres of inhibition being thus the essential factor of attention, constitute the organic basis of all the higher intellectual faculties; and in proportion to their development we should expect a corresponding intellectual power" (p. 287).

When an artist wishes to call special attention to some object in his picture, he does so by means of colour, illumination, &c. But there are limits imposed by his materials. To effect his object, therefore, he throws the surroundings or accessories more or less into shadow, and the principal object to which he is desirous of attracting the eye stands out in a corresponding manner.

In a mental picture a similar result is effected by the power of attention, which I have to some extent endeavoured to elucidate.

NOTES ON THE SYMPTOM-SIGNIFICANCE OF DIFFERENT STATES OF THE PUPIL.

BY JONATHAN HUTCHINSON, F.R.C.S.,

*Senior Surgeon to the London Hospital, and Consulting Surgeon to the Royal
London Ophthalmic Hospital.*

(Continued from page 167.)

I HAVE in the latter part of my paper cited a number of clinical cases in illustration of the condition assumed by the pupil in loco-motor ataxy and allied conditions. The subject is a very extensive and complicated one, and I must ask permission to bring forward yet other facts before venturing to state any general conclusions. I may, however, here again say that the impression derived from the study of these cases has been that we may usually accept paralysis of the iris, or of either part of it, when unattended by proved defect of other parts of the third nerve, as probably indicative of disease in the lenticular ganglion. It was an early conjecture of Dr. Duchenne of Boulogne that loco-motor ataxy itself was due to disease in the vaso-motor system, and the frequent association of small pupils with defect in the power of the bladder, to which I adverted at p. 156, had not escaped his attention. The theory which would associate the disease, to which this wholly inadequate and much misleading name has been given, with the vaso-motor system, has long been abandoned, but it by no means follows that it is not attached in many cases. The best definition, so far as I can see into the subject, would be a state of system in which the patient is liable to the occurrence of neuritis, affecting now one and now another region and structure, in some cases transitory, in others chronic and leading to

atrophy. The fixed pupils, the optic atrophy, the local occurrence of numbness, the attacks of ptosis or strabismus, and many other evidences of localised changes, are as much parts of the disease in question as is the ataxy which has given it a name. Probably we ought to regard the latter as merely one of its symptoms, and as occurring only when a certain definite part of the spinal cord is affected. This view will, it is admitted, greatly widen our conception of the malady, but it seems to me that we cannot consistently with clinical facts stop short of it. Let me add that it appears to me incontestable that the previous occurrence of syphilis leaves the nervous system in a condition remarkably prone to this kind of flying neuritis, and further, that attacks are often brought on by causes which temporarily reduce the nerve-tone. This reduction of nerve-tone, conducing to local inflammation, may be either local or general. Hence the connection between sexual exhaustion and the more definite forms of ataxy, in which the lower extremities chiefly suffer. On this theory, when the pupils become motionless, we must suspect neuritis of the lenticular ganglion, or of the vaso-motor trunks.

I had treated Mr. T., a young artist, for primary and secondary syphilis in 1875. In July 1878 he came to me again, having had several epileptic fits during the preceding six months. There was a strong liability to nervous disease in his family. I found his right pupil about natural size, and absolutely motionless, and in this eye the function of accommodation was wholly lost. The left pupil was a little larger than the right, and possessed a slight amount of power of dilatation and contraction, whilst its power of accommodation was perfect. My inference was that the lenticular ganglion was attacked on both sides, and disorganised on the right. None of his recti were weakened and he had no ptosis. The existence of a gemma in one testis made it clear that his tissues were still prone to syphilitic inflammation. Soon after this Mr. T. had a week's attack of uncontrollable vomiting, with diarrhoea. He has as yet none of the pains of ataxia, nor is his walk affected. It is clear that the sexual system takes a share in producing the symptoms, for he has emissions without erection or sensation,

and is liable to feel giddy on the slightest approach of erotic excitement.

Mr. M., a gentleman of middle age, was under my care for syphilis in 1875. In the summer of 1878 he came again, with his right pupil dilated and fixed, and accommodation wholly lost. He had no other symptoms, and I diagnosed a gumma in the lenticular ganglion of the affected eye. He wholly recovered under two months' mercurial treatment.

I find it very difficult to abbreviate the following narrative without omitting something which may be important to its correct appreciation. Its connection with my present subject lies in the fact that there is absolute ophthalmoplegia interna in both eyes. The pupils are quite motionless and accommodation is lost. This condition, indicative probably of disorganisation of both lenticular ganglia, occurs with symptoms of general nervous depression, anaphrodisia, tremulous gait, &c., allied possibly to the state known as "general paralysis of the insane" (better to be expressed, perhaps, as general progressive paralysis, with mental disturbance).

William Tucker, 50, a labouring man of steady habits, the father of eight children, became a widower at the age of 46. After an eight months' interval, he married again—a woman somewhat his junior. Soon after his second marriage he began to complain much of pain in his legs, and excessive fatigue in the evening. When he came home it was always "Oh my poor legs, my poor feet!" The feet used to swell somewhat and the soles became rough. At this period he regularly did his day's work. He had had much trouble, and it is suggested that his gait had been peculiar for some time before. Very soon after his marriage he became dull and melancholy.

About six months ago he lost his employment, owing to the failure of his employer; and not long after this he had his coat stolen, and was much annoyed. On the evening of this day he became delirious, and there then followed a three months' illness, the first two of which were spent in bed. This illness was characterised by mental depression, and a conviction that he was eternally lost, and also that he would be apprehended by the police. He was not paralysed. On recovery from this illness he was dull in every respect—slow

in speech, deficient in memory, feeble in gait, and with trembling hands. He had a delusion that he had some "bad disorder," it being apparently caused by the presence of a rupture. It should have been stated that his sexual power had been greatly diminishing before the illness, and after it was wholly lost.

With this history William Tucker came two months after the illness under care at Moorfields. It was then found that he had iridoplegia interna complete in both eyes. He had wholly lost accommodation, and the pupils were motionless (at 2); with convex glasses (+ 4 D) he read J 1, whilst without he saw only J 16. His accommodation had been failing before the illness. The two eyes were much alike. There was no paralysis of external muscles. Atropine was used for the right, and dilated the pupil moderately. The disc was seen to be uniformly pale, and the arteries somewhat smaller than natural.

He walked in a tremulous, feeble manner, but I could not establish that it made any difference whether his eyes were closed or not. The patellar reflex was good.

He has a vacant restless look, and is constantly fumbling with his hands. His memory is slow, but he generally in the end remembers what he wants, and will sometimes correct his wife's omissions. His bladder is probably weak, but he has had no retention, and has never had involuntary escape.

There were some symptoms of rather definite difference from loco-motor ataxy. Excepting headache, the man had had no material pain, no shoots in the limbs; no transitory paralysis had occurred, and the patellar reflex was present. Still, probably the condition is very closely allied to it, the differences being explained by the different parts of the nervous system attacked. There had never been any degree of the elation so common in the general paralysis of the insane, but, on the contrary, depression from the beginning.

In 1874 I saw a Mr. S., aged 50, in whom there was an imperfect history of syphilis eighteen years before. He was married, and had recently been under treatment for debility and low spirits. He came to me with symptoms of disorganisation of the left lenticular ganglion. The pupil was fixed,

twice the size of the other, and accommodation lost. He could read perfectly well with + 9. He gave the history of having been treated by Mr. Dixon ten years before for paralysis of the third nerve in the right side. Of this he recovered perfectly, but the pupil of that eye was now smaller than natural, and only moderately active. I treated the case as syphilitic. The long interval between the two attacks was of interest, as also the fact that the paralysed pupil was dilated.

This morning I have examined G. A., a man of 40, whose pupils are absolutely motionless, and rather smaller than natural (between 2 and 3). He retains accommodation, and has no paralysis of any of the recti, but he is somewhat amblyopic (unequally so), and his discs are pale. The motionless pupils have, however, nothing to do with the failure of sight, for he still reads the newspaper, and they are clearly in connection with the vaso-motor system. He has also partial paralysis of the bladder, and complete anaphrodisia. He is the subject of loco-motor ataxy, induced by sexual excesses, combined with whisky-drinking and over-smoking.

It is difficult to estimate accurately the signification of a motionless pupil. May a pupil be motionless when one set of the iris fibres, circular or radiating, is paralysed? Thus, if the third nerve is affected and the pupil dilated, will it be quite motionless; or if the vaso-motor and the pupil are small, again will it be motionless? Can one set of fibres alone give mobility, or is it necessary to have an antagonist?

So far as observations in cases of injury to the vaso-motor trunk in the neck go, it would seem probable that the pupil in them is not quite fixed. Sir James Paget, in recording such a case (see 'Medical Times and Gazette,' March 26, 1864), writes: "The pupil on the injured side is always smaller than the other, but they both act equally well." My own observation¹ of similar cases has been to the effect that the pupil acts very little. On shading it scarcely any dilatation is observed, but a certain degree of additional contraction may be induced by exposure to bright light. No doubt differences must be expected in relation with differences as to the completeness of the paralysis.

¹ See 'Clinical Illustrations,' Vol. I page 267, *et seq.*

In most of the common cases of motionless pupil in connection with syphilis, or the early stage of loco-motor ataxy, there is but little reason to suppose that the cervical vaso-motor trunk is affected. Retraction of the eye-ball and non-symmetrical flushing and sweating are not, I think, usually observed. This would help us to the diagnosis of disease located in the ganglion, and the same inference follows the observation of immobility just adverted to. It is extremely to be desired that microscopic examination of the lenticular ganglion and of the vaso-motor nerve generally should be made in a number of these cases. Our workhouses and lunatic asylums must furnish not infrequent opportunities, which, if utilised, would set at rest the doubt which still surrounds the hypothesis that in ophthalmoplegia interna this ganglion is the seat of disease. I have often proved that in iridoplegia the iris will still respond to stimulation by atropine and eserine. It usually does so slowly and not to the full extent, but still the action is very definite. The very rare cases in which the iris will not respond to these drugs have not yet been examined with the care they merit. Apart from the results of glaucomatous tension and like conditions, an absolutely non-excitabile iris is extremely rare, whether with myosis or dilatation. With myosis, I believe, it is seen only in the aged, and is probably indicative of changes not only in the lenticular ganglion, but also in the choroidal and iridal nerve-cells.

General Paralysis with Insanity.

The state of the pupils in this affection has received some attention, but without any definite results beyond the general observation that want of symmetry as regards the size of the pupils is very common.¹ Dr. Lawson, in the paper from which I have already quoted, lays great stress on this fact, and endeavours to establish the law that when local lesions are

¹ I find that writers on brain disease are in the habit of speaking of "irregular pupils" when inequality of size is all that is meant. Ought not the term irregular to be reserved for pupils the margins of which are crenated? The crenate margin is of course usually caused by adhesion, and is simply a proof of past iritis. Can a crenate pupil ever be caused by any other condition? I ask in ignorance, having found it mentioned as if it were not uncommon.

present in excess on one side, the pupil on that side will usually be the larger. If convulsions occur they will consequently be on the side of the smaller pupil. A table, showing the exact measurements of the pupils in a considerable number of cases, is given, and from it we gather that one pupil may sometimes be twice the size of its fellow, and that the absolute size may vary within wide limits. Unfortunately, however, the value of the record is diminished by the omission of information as to the age and state of refraction in the patient, and above all as to the mobility or otherwise of iris. In a few cases the pupils were unduly large, but it may chance that these were young persons, or perhaps myopes. It is impossible to tell whether the smaller or the larger pupil was the one which deviated from the natural standard, unless we are informed whether both or either were active. Dr. Lawson's table, at any rate, makes it clear that deviations from symmetry in size are common, and that neither they nor differences from the normal size appear to have any special relation to the stage of the disease. In not a few cases, at periods varying from a few months to five or six years, the pupils appear to have been of equal and natural size. I cannot help suspecting that their activity, or loss of it, is a more important symptom than relative difference in size, at any rate it certainly should be studied concurrently. In the same volume is a very valuable report by Dr. Crichton-Browne on the pathological anatomy of this disease. The detailed reports of several well-marked cases are given, and in some the condition of the pupils is noted. Quoting from Dr. Clifford Albutt, Dr. Browne speaks of "contraction of the pupils, which constitutes one of the most familiar signs of the disease in its earlier stages." Amongst the "motor symptoms" of the disease are mentioned "changes in the pupils, which are at first singularly contracted, and then became singularly dilated." In Case I. the notes record "pupils irregular, the right larger than the left." In Case II., "pupils equal, but sluggish." In Case III., "pupils unequal, the left being the larger." In Case IV., "left a little larger than right; both active." In Case V., "pupils equal, but contracted;" and in Case VI., "pupils somewhat unequal, but active." These were all severe

and progressive cases, which ended fatally after short intervals. We may then, I think, assume that, excepting the fact of frequent non-symmetry, nothing definite has been established as to changes in the pupils in this disease, and it would be premature to attempt to explain the cause of the inequality in size. Further observations would probably prove of some value.

Exophthalmic Goitre (Basedow's Disease).

In this affection I believe there is, as a rule, no alteration in the state of the pupil. I have examined the eye in a certain number of cases with especial reference to this point, and have found the pupil of natural size and quite active. Nor is the function of accommodation affected. These negative results are of the more interest, because the malady is usually attended by evidence of derangement of balance in the vaso-motor system, as shown by dilated and throbbing arteries.

Paralysis Agitans, &c.

Exact observations are wanting in reference to alterations in the pupils in paralysis agitans, disseminate sclerosis, and other conditions of chronic disease of the nervous system. In paralysis agitans the pupils are, I believe, usually small, but it may be doubted whether more so than is to be accounted for by the age of the patient. To speak generally of those diseases of the nervous centres which are chronic and may vary as to precise locality, probably in not a few important aid might be expected from a careful examination of the pupils in a good light. The observer should direct his attention not only to their size, but especially to their activity, and both size and activity should be estimated in each eye separately with great care, in order to avoid fallacies. It is never safe to rely on the results obtained by a single examination. A main object of the examination should be to determine whether the abnormal condition be due to spasms or to paralysis.

In acute dementia (oedema of cortex cerebri) observers state that the pupils are invariably dilated.

Dr. Lawson,¹ in the paper which I have already several times referred to, makes some important observations on the value of reflex excitability of the pupil as an indication of the state of the spinal cord. If the foot be pricked or irritated, the pupils will at once dilate, provided the sensory columns of the cord are intact and the irido-motor apparatus uninjured. This dilatation occurs independently of volition, and may be a means of detecting imposture, or of correcting mistaken impressions as to the degree of anæsthesia. Dr. Lawson found this reflex excitability definitely diminished in a very large proportion both of epileptics and general paralytics.

On Mydriasis with and without Cycloplegia.

When dilatation of the pupil (mydriasis) results from paralysis of the third nerve, or of some part of it, the ciliary muscle usually fails as well. If the third-nerve recti suffer, the diagnosis is clear, and if they wholly escape we can only suspect that the disease is seated in the short root of the ganglion itself. I have seen a few, and only a few, examples of this condition. In one I suspected the existence of a syphilitic neuroma in the short root.

The access to atropine or belladonna on the part of the public is now so easy that we cannot be surprised that we often encounter mydriasis as the result of an accidental and perhaps unknown use of this agent, or of its use with intention to deceive. It is the first question which will occur to a surgeon on seeing a dilated pupil, "Has atropine been used?" and he must be on his guard in cases of hasty denial. Many patients deny at first that they have used drops, in whom cross-examination will establish the fact. Either it had been forgotten, or the drops had been put in by a chemist or surgeon, and not thought to be of importance. Not unfrequently, however, the ophthalmic surgeon has to encounter cases of intentional deception. These occur usually in young women of emotional tendencies. Not a week ago a highly cultivated young lady consulted me for "pemphigus." She had blebs all over the left half of her body. But these blebs were, some of

¹ See page 275 of Vol. IV. of the 'West Riding Asylum Reports.'

them, not round but oblong—in a style which no skin disease ever assumes, and very obviously the result of the application of a brush. She was liable also, I was told, to attacks of dilatation of the pupils and loss of ability to read. These attacks usually lasted a week. This case is only an example of what has frequently come under my notice. Although it is possible to use atropine in such a weak solution that the ciliary muscle is not affected, yet in most of these cases a more complete effect is obtained, and the loss of power to read is produced in addition to mydriasis. If the latter be present alone, and if it persist for long, the suspicion of deception may be put aside. Mydriasis of this kind is exceedingly rare, and the following is one of the very few examples of it which I remember to have seen.

Miss S., a girl of 13, apparently in perfect health, was under my treatment in December 1875 for mydriasis of the left pupil, which had then existed for two years. The pupil was very widely dilated, but accommodation was not lost, and she read No. 1 at varying distances. There was no squint and no ptosis. Until the last few months she had never made any complaint of her sight, but latterly she had sometimes said that the eye was misty, and that it ached after much use. This might have been due to exposure to strong light or, possibly, to slowly progressive failure of accommodation. The history was that just before the mydriasis was observed she had twice taken gas for tooth extraction, but she was not in the least out of health. She used sometimes to wake screaming in the night. Galvanism had been tried without result for four months before I saw her. I ordered eserine discs to be used regularly. These induced some contraction of the pupil, but it always dilated when they were disused. Three months later her mother reported that she was in the same condition, but that once under strong excitement the pupil had contracted. It was reported to have contracted also to a very small size from exposure to a cut onion. Six months later the state of things was still the same, the effect of Calabar bean lasting only twenty-four hours. I have not seen Miss S. since this date, as she lives at a great distance, but a letter from her mother brings her history up to the present time, three years from the

above notes and five from the commencement of the mydriasis. Her mother writes (December 6, 1878) that the use of Calabar bean was discontinued two years ago, as it produced no permanent results, and that the state of the eye is just as it was. It is noticed, however, that sometimes in the evening, when wearied, the pupil will contract to the size of a pin's head, and that this is attended by eye-ache. She still retains the power of accommodation, but cannot read small print for long. Two years ago she was seized whilst out walking with weakness in the left limbs, her arm hung by her side and her leg was dragged, but with assistance she walked home. A few months ago another slighter attack of paralysis occurred, which had been preceded by severe headache. She is unable to bear excitement or fatigue, and all school work has been discontinued. The partial hemiplegia was in each instance soon recovered from. It is to be noted that the hemiplegia was on the same side as the mydriasis.

It has only recently come to my knowledge that in certain cases the long-continued use of atropine drops may be followed by persisting mydriasis. I have witnessed this result in several cases, in all of which atropine had been used for months during the course of syphilitic keratitis. In each of these the pupil remained widely dilated for many months after the drops were put aside. Accommodation was not affected. In one instance, still under treatment, eserine drops have been used for two months to counteract the mydriasis; under their employment the pupil contracts well, but it soon re-dilates. It is of interest to note that the subjects of all these cases were young. The older the patient the less easy is it to stimulate structures under the control of the vaso-motor system and the greater the tendency to contraction of the pupil. It is well known that in cases of senile cataract atropine may be used for years without the least tendency to permanent mydriasis.

In some cases of frontal or facial neuralgia dilatation of the pupil is observed on the affected side. This is probably due to spasm of the radiating fibres, but it needs better investigation. Du Bois Raymond notes it in cases of "Megrim."

In cases in which extreme contraction or dilatation is

the rule, in one or both pupils, it will sometimes happen that under especial circumstances the condition is reversed. Thus, as just narrated in the case of Miss S., a pupil which habitually was in a state of mydriasis may become much contracted. In this case inexplicably the contraction was induced apparently by fatigue. Usually the reverse is the fact, and fatigue, or its equivalent—long-continued pain—causes the pupil to dilate. It is a common observation of authors that the contracted pupils of loco-motor ataxy become dilated during attacks of the severe pain which so frequently form a part of this malady. I have had no opportunity for personally confirming this, but several patients in whom the pupils, so far as I could tell, were motionless, assured me that at times great alterations in size occurred. I doubt whether pain is always an antecedent of such changes. When such changes occur they may probably be taken as proof that the disorganisation of the affected parts is not nearly complete. In his able paper in the 'West Riding Asylum Reports,' Dr. Robert Lawson mentions a case of general paralysis in which ordinarily the left pupil was the larger. During an attack of convulsions, limited to the right side, the right pupil became the larger, but two hours later the relations were as before. He observes, also, that the effect of a convulsive seizure in cases of unequally sized pupils is almost invariably to alter the relative conditions for a time, the pupil always dilating on the side on which the spasms occur.

When both pupils are in a state which may be called functional mydriasis (dilatation independent of paralysis), it may be inferred that the blood-vessels are contracted, and that the patient will be restless, uncomfortable, and very likely troubled with sleeplessness. I am assuming that the eyes are not myopic. Mydriasis of this kind always implies the need for rest. It is usually seen with pallor of the cheeks. A gentleman who consulted me a week or two ago had pupils of very large size (seventeen when not fully exposed, and ten when brought to the window). He was excessively restless, and appeared to be on the verge of delirium tremens. He was a church organist, and his restlessness took the troublesome form of an entire inability to sit out the sermon.* Whilst engaged in the

organ-loft he got on very well, but with nothing to do but listen, he could not keep still. He slept badly, and owned that often in the middle of the night he was obliged to resort to spirits. Many persons had recently remarked to him on his large pupils, and he remembered that the same once occurred to him when a boy at school.

(To be concluded.)

PAIN IN THE HEAD IN CONNECTION WITH CEREBRAL DISEASE.

BY DAVID FERRIER, M.D., F.R.S.

It seems at first sight strange, not to say unaccountable, that the centres of sensation and perception are themselves devoid of sensibility or sensitivity, and may be cut, lacerated, burnt, or otherwise injured, without the slightest indication of local suffering being manifested. That this is true of the brain substance is so generally accepted on the evidence both of human pathology and experimental physiology, that it is scarcely necessary to argue the point. I have myself frequently verified it in the case of monkeys and other animals. After exposure of the brain, I have found that injuries which would cause acute pain if inflicted on other tissues and organs might be inflicted on the brain substance in an animal in full possession of consciousness, and free to express feeling by any of its usual modes of manifestation, without exciting any signs of painful sensation.

When, however, we examine the conditions of sensitivity in tissues and organs which we know to be sensitive, the insensibility of the brain substance presents nothing extraordinary. Tissues and organs which are endowed with sensibility, whether in normal or abnormal conditions, are so in virtue of certain peripheral end-organs or nerve terminations, capable of being affected by what are termed stimuli, general or special. These organs are connected with a nerve centre by means of a nerve trunk, of greater or less extent. Without this triple combination, the conditions of sensitivity do not exist, and we cannot speak of the various parts of the apparatus as sensory except in relation to each other. Hence,

apart, they have only the general properties of nerve tissues, but they have no functions capable of being designated as sensory. Strictly speaking, we should not speak of sensory and motor nerves and nerve centres, but of sensory and motor *apparatus*:—the sensory being peripheral organ, nerve and centre, the motor being nerve cell, nerve and muscle.

The function depends on the collocation, as Lewes puts it.

The brain substance not being supplied with nerves and peripheral end-organs, injuries of the brain tissue cannot be felt as local pain, but will be manifested in disorders of the functions of the apparatus of which they form a part. Disease of a nerve centre which forms part of a muscular apparatus will show itself not at the seat of the lesion, but at the point where functional manifestation takes place. Hence it is a disorder of motility.

Disease of a nerve centre which is in relation with a peripheral receptive organ will be manifested as a disorder of receptivity or sensibility, not at the seat of lesion, but at the periphery where the end-organs are distributed.

Even when the peripheral organs no longer exist, diseases of those parts of the sensory apparatus still remaining are referred to the periphery with which they were formerly connected. In consequence of the organic memory of the nerve centres, functional excitations are projected peripherically, a fact which shows that the sensory apparatus must be regarded as a whole.

The brain centres being in relation either with muscular apparatus or peripheral sense organs, and being, further, the substrata of subjective or mental manifestations, diseases of the brain may manifest themselves either in mental derangement, or in affections of motility and sensibility, or both; but as the brain tissues are devoid of nerves, they are devoid of sensibility, and cannot express their morbid states in local pain.

We know, however, that certain diseases of the brain, in addition to the other indications of their presence, are accompanied with the most excruciating pain referred locally.

It would be very unsafe to diagnose cerebral disease from the character of the headache alone, and it would probably

be erroneous to refer headache in all cases of cerebral disease to an intracranial seat. But the headache in many forms of cerebral disease is of such a character, so all-absorbing in its intensity, differing much from all other forms of headache, sympathetic, neuralgic, &c., and in particular because it frequently exactly corresponds with the seat of the disease and may be intensified by local irritation, that we may regard it as certain that the pain is intracranial, and that therefore the brain may indicate its disease by local suffering.

If it is true, as above laid down, that the brain substance is devoid of sensibility, and cannot under any conditions become sensitive, the seat of pain in cerebral disease must be sought elsewhere than in the brain tissue itself. It has, however, been advanced by Andral and others that though the brain is not sensitive under ordinary conditions, yet, like membranous structures which ordinarily possess little or no sensibility, it may become sensitive in morbid conditions such as inflammation. But there is no analogy between the two. For membranous structures which, under morbid conditions, may become the seat of acute pain are not devoid of nerves, while the brain substance is absolutely so.

But though the brain substance is devoid of nerves, it is invested and enclosed by membranous envelopes, and the view which has commended itself to many writers, both on theoretical grounds and from a consideration of the painful forms of cerebral disease, is that the seat of pain is in the cerebral membranes, particularly the dura mater.

That the dura mater is sensitive is a fact which, though at one time much contested, may now be regarded as firmly established. There may be some doubt as to the exact origin of the nerves which are distributed to the dura mater, but it is tolerably certain that they are mainly derived from the fifth.

Luschka regarded these nerves as purely vascular; but Alexander ('Archiv für mik. Anat.' 1857) has demonstrated their distribution in the substance of this membrane.

It has likewise been demonstrated experimentally that certain forms of irritation, such as pinching, tearing and

inflammatory conditions, give rise to indications of acute suffering in the lower animals. I have observed this especially in the comparatively thin dura mater of some of these. Duret, in a former number of this Journal ('BRAIN,' Part I.), has called attention to the important part which irritation of the nerves of the dura mater plays in traumatic cerebral lesions.

The sensibility of the dura mater is of much the same character as that of fibrous membranes generally, of which it was at one time supposed to be the origin or mother. This is not particularly obvious except under conditions of abnormal tension, wrenching or inflammation. In consequence of the comparatively sparse distribution of nerves, membranes possess little power of localisation, hence a limited irritation may cause diffused pain, or a general irritation may be referred to one spot, as we see in affections of the periosteum and serous membranes. The degree of localisation largely depends on the number of nerves distributed to a part.

Though there thus appears to be no doubt as to the sensibility of the dura mater, the question is whether in all cases of intracranial pain it is possible to show the existence of such conditions as are calculated to cause irritation of the nerves of the dura mater, viz. abnormal tension or inflammatory action. If it should appear that there are forms of intracranial disease associated with pain in the head, complained of spontaneously or capable of being made manifest, in which, so far as can be judged, no conditions exist likely to cause irritation of the nerves of the dura mater, we have to inquire whether it is possible to refer the pain otherwise than to the cerebral tissue itself.

Besides the dura mater there are two other membranes investing the brain, the arachnoid and pia mater, or rather one membrane with two layers more or less closely united, the arachno-pia or, shortly, the pia mater. Pathologically, at least, we can scarcely regard them as separable and distinct.

The pia mater is generally regarded as insensitive. Nerves, however, have been traced to it by Luschka, Bochdalek, and others. These are regarded by Kölliker as belonging exclusively to the blood-vessels, and derived, like other vaso-motor

nerves, from the sympathetic. As to the branches from the sympathetic there can be no doubt, but the existence of others which have been traced from the roots of some of the cranial nerves, as well as from the crus and medulla, is very questionable.

No indications of pain are, so far as can be judged, observable on electrical irritation of the pia mater in the lower animals. The calibre of the blood-vessels alone seems altered, as on irritation of vaso-motor nerves in general. But this does not exclude the possibility that the pia mater may, like other tissues supplied only by the sympathetic, under certain abnormal conditions, such as inflammation, become the seat of pain, its organic sensibility, according to Bichat, being transformed into the sensibility of relation.

Bichat regarded the arachnoid as so sensitive.

And that the pia mater, though only possessing vascular nerves, may become painfully sensitive is supported by the phenomena of arteritis and phlebitis, and by the acute pain experienced on traction on the ligature of an inflamed and ulcerating vessel. The sensibility of the vascular walls has received little attention, but they were regarded as sensitive by Bichat and others. It is not unlikely that hyperæsthesia of the vascular walls in inflamed parts may be partly the cause of the peculiar throbbing pain synchronous with the pulse, which is then experienced. And to tonic spasm or cramp of the vascular walls, Helmholtz, as is well known, attributes the acute pain of hemicrania, which he has studied minutely in his own case.

It is probable, therefore, that the pia mater, though apparently insensitive, may become the seat of pain under conditions of disease, and this view is supported by a consideration of certain forms of cerebral disease, in which, without evident affection of the dura mater, pain is spontaneously complained of or may be elicited by percussion.

If these considerations are justified, an analysis of the phenomena of cerebral disease ought to show that those forms of disease are especially associated with headache in which there is undue, and more particularly rapid, increase of the intracranial pressure, or in which there is inflammation of the

dura mater, or of the pia mater primarily or secondary to encephalitis.

That those diseases are associated with intense headache in which there is abnormal increase of the intracranial pressure and thereby undue tension of the cerebral membranes is amply justified by clinical facts. And that undue tension alone is a sufficient cause of pain in the head is tolerably clear. For though in many cases tension is accompanied by inflammation, and is the result of the inflammatory process, yet this is not always so, and there seems a distinct proportion between the intensity of the pain and the amount and suddenness of the tension. To this must be ascribed almost exclusively the intense headache which accompanies cerebral tumours. These are sometimes complicated with inflammation, but the pain may be excruciating in the absence of inflammatory action.

To abnormal tension we may also ascribe, in great measure at least, the pain which accompanies pachymeningitis interna, or hæmatoma of the dura mater, meningeal hæmorrhage, acute hypertrophy of the brain, rapid effusion into the ventricles without evident inflammatory indications, as in leptomeningitis infantum, rapidly increasing cerebral abscess, and generally rapid increase of the intracranial pressure, whether associated or not with inflammation of the membranes.

The tension on the membranes will naturally be produced wherever the distending cause may be situated; whether, therefore, it is central or superficial, but the membranes will suffer more partially if the disease is superficial than when it is central. Hence, besides the general symptoms of increased intracranial pressure, there may be more or less localisable pain of a specially severe character.

What amount of tension in excess of the normal intracranial pressure is necessary to cause pain in the head we have no data for estimating exactly. But it would appear that severe pain may result from a degree of tension which falls far short of exerting destructive pressure on the vital centres of the pons and medulla, or inducing obvious stasis in the retinal veins. It is doubtful whether mere engorgement of the cerebral vessels is sufficient to cause headache by tension, for the equally great, if not greater, tension induced by

powerful expiratory efforts, or long-continued muscular strain, does not commonly cause headache. The headache of so-called congestion of the brain is more probably a concomitant symptom of a general condition, the pathology of which is obscure, than a mere mechanical result of vascular engorgement.

Next, as to inflammation. That diseases of the brain and its membranes of an inflammatory nature, whether simple or specific, are accompanied by excruciating pain before tension, resulting from the products of inflammation, can have appreciably increased is evident from the phenomena of meningitis, whether simple, tubercular, or syphilitic. There is no difficulty in accounting for the pain when the inflammation affects the dura mater. But acute pain may be felt, more or less referable to the seat of disease, in which the inflammatory action does not, as far as can be seen, implicate the dura mater, either primarily or secondarily. In such cases, unless we suppose some obscure or indirect irritation of the nerves of the dura mater, it is more reasonable to regard the pia mater as the seat of pain.

In tubercular meningitis, in which the pia mater is the primary seat of the disease, pain is frequently intense before the occurrence of tension from inflammatory products, and without any evident affection of the dura mater.

Also in syphilitic affections of the cortex pain in the head is a characteristic symptom, and this, too, in cases where the dura mater, cranium or pericranium is not obviously affected. The fact pointed out by Buzzard that attacks of syphilitic epilepsy are often preceded by localised headache, though not excluding general affection of the meninges, may be taken to support the view that the pain and irritation of the cortex are intimately related to each other.

In encephalitis pain is frequently intense without any implication of the dura mater in the inflammatory action. In the cases classed under the general head of "ramollissement," Rostan regarded as a pathognomonic sign the fact that the patient, even when plunged in semi-stupor and hemiplegic, would, when asked, point with his free hand to the same side of the head as the seat of pain.

It has frequently been observed that the nearer the disease approaches the cortex, the greater the indications of pain.

In the ganglia and medullary substance of the hemispheres it is not unusual to discover affections of an inflammatory nature, or surrounded by a zone of inflammation, which have run their whole course without pain. Thus cerebral abscess situated in certain parts of the hemispheres may be latent not only as regards cerebral symptoms but also as regards pain in the head, particularly when it forms slowly and merely replaces normal brain tissue without adding much to the volume of the cranial contents.

In ninety-nine cases of cerebral disease analysed by Mr. Callender there was not one accompanied with pain in the head when the ganglia alone were the seat of lesion. In ordinary central hemiplegia depending on effusions, &c., into the ganglia, pain is rarely complained of spontaneously, and is not, so far as I have found, elicited by percussion. The sudden increase of pressure which results from a hæmorrhagic effusion ought, in accordance with the principles laid down, to cause acute pain in the head; but as consciousness is obscured at the same time by pressure, the pain cannot be said to exist, though it is frequently complained of when consciousness returns, and before the abnormal tension has disappeared.

But apart from the indirect effects of pressure, there does not seem to be any pain associated with hæmorrhagic lesions in the central ganglia or substance of the hemispheres.

It rather militates against the inflammatory nature of the cortical affections in general paralysis, or at least points to some peculiarity—possibly the very chronic character of the process—that the subject of it appears to be free from headache. Crichton-Browne, however, finds that this freedom from headache is by no means constant, and that sometimes there are indications of excruciating pain in the head, a fact which strongly supports the view that it is a form of meningo-encephalitis.

It would appear, therefore, that those diseases are especially painful which directly or indirectly affect the cerebral membranes, and that we have reasons for regarding the pia mater as well as the dura mater as the seat of the pain. Other facts

to be mentioned below are, in my opinion, only explicable on this hypothesis.

Next, as regards the locality of the pain in cerebral disease. Though this frequently coincides exactly or approximately with the seat of lesion, a fact which is the best indication of the intracranial origin of the pain, yet the rule is by no means constant, and it would lead to serious error if the locality of the pain were taken by itself as a guide to the position of the lesion. The situation of the pain corresponds to the position of the lesion, more particularly in cases of cerebellar disease, or disease in the posterior fossa of the skull. In the vast majority of instances the pain is referred to the occipital region. In some cases, however, of cerebellar disease the pain is referred to the frontal region. As a general rule the less localisable the pain is, the greater the tendency to refer it to the frontal region: Why this is so we cannot satisfactorily explain. But that the frontal region is the *lieu d'élection* in most cases of headache of sympathetic origin and in many cases of organic cerebral disease is undoubted. It is not difficult to account for the localisation of the pain in the occipital region in cases of cerebellar disease, particularly tumours, when we consider how the posterior fossa of the skull is cut off from the rest of the cranial cavity by the tentorium, and how therefore the tension is mainly concentrated in a comparatively closed space.

In affections of the cerebral hemispheres, though the pain is often correctly referred to that part of the cranium overlying the disease, yet this is less constant than in cerebellar disease. Often the pain is diffused, and if it is referred to one particular region this does not always correspond with the position of the lesion. In sixteen cases of meningitis Andral found five in which the headache was vaguely referred to the whole head. In eleven, the pain was referred to a limited region. In six of these only did the situation of the pain correspond to the situation of the disease. In the other five there was no correspondence between the two. In one the disease was in the left hemisphere, and the pain was referred to the forehead. In the second the pain was referred to the left side of the head, and yet the meningitis was general. In the third the

pain was referred to the temples, and the meningitis was basilar. In the other two the disease was in the ventricles, and the pain was referred to the forehead. In the five cases, however, in which the pain was not localised, the disease was also general, except in one in which the lesion was restricted mainly to the frontal regions. It is rare, therefore, to have localised headache when the disease is not also circumscribed. What is true of meningitis holds also in reference to encephalitis and other organic cerebral diseases in which pain is complained of.

The locality of the pain, therefore, even when it is circumscribed, cannot be taken as a faithful index of the situation of the disease, and we have to rely mainly on the nature of the functional disturbances for our regional diagnosis. Here, however, we have to encounter the difficulty of determining in a given case whether the lesion is actually situated in the part or centre the functions of which are particularly affected, or situated at some distance, acts only indirectly by pressure or otherwise on those parts, the functional derangements of which are the chief or only obvious symptoms. This is a question which it would be of the highest importance to be able to answer decisively, more particularly in view of local treatment or surgical interference. If trephining for cerebral disease other than in cases where there are clear external indications should become more generally practised; every indication will be of value which may serve to fix the exact position of the lesion.

It is with this object that I desire to call the attention of physicians to percussion of the skull in cerebral disease, even when the patient makes no spontaneous complaint of pain in the head, as an aid in fixing the locality of cerebral lesions, more particularly those of the cortex. I have frequently been struck with the existence of pain on percussion over the cranial region, corresponding to the situation in which from other facts I had been led to localise some lesion; or the intensification of the pain spontaneously complained of in some particular spot where it had been more or less vaguely felt. Theoretically nothing seems better calculated to intensify pain, or elicit it, in hyperæsthetic parts, than the jarring which is caused by smart percussion over the region affected. This I have found to be the case even when the lesion was

evidently of an embolic nature, a fact which appears capable of explanation only, or at least most probably, on the view that the pia mater is the seat of pain, and rendered hyperæsthetic by the inflammatory zone described by Hasse as surrounding the necrosed part.

The following are a few examples illustrative of the foregoing remarks.

In a female patient under the care of Dr. Clouston in the Morningside Asylum, who had been admitted eight months previously with symptoms of excitement, aphasia and paresis of the right arm and right side of the face, I found that percussion in the left temporal region over the anterior inferior angle of the parietal bone caused acute pain. The patient did not complain of pain in the head spontaneously, and only in this region was percussion painful. Dr. Clouston informs me that this tenderness on percussion continued for twelve months afterwards. The aphasia still remains.

This patient is subject to angina pectoris, the heart is hypertrophied, and the sounds are muffled, but there is no distinct murmur. Though the nature of the lesion is not quite certain, the facts are in favour of embolism.

The pain in this case was of long duration, but occasionally it is very evanescent.

Thus in a case of right brachio-facial paralysis, with slight aphasia of two days' duration, which came under my care some months ago at King's College Hospital, there was pain on percussion in a similar position in the left temporal region. The pain, however, had disappeared a few days subsequently, when he was admitted into the hospital. The patient quite recovered from his attack in a few weeks, but returned shortly after being discharged with a similar affection of the left arm and left side of the face, but without aphasia. There was no pain on percussion this time, and the symptoms again rapidly disappeared.

In January last a female patient came to me at the Hospital for Epilepsy and Paralysis, suffering from paresis of the right hand and right side of the face. Sensation and electrical reactions were normal. There was no aphasia. She stated that a few days previously while in the act of pouring out tea

she suddenly dropped the teapot, and found she had lost the use of her right hand. The history as well as the existence of distinct presystolic murmur clearly pointed to embolism. She complained of no pain in the head. But on percussion a painful spot was found just above the left ear, a region corresponding to the position of the lower extremity of the ascending parietal convolution, lesion in which would readily explain the symptoms. The pain gradually diminished, and disappeared on recovery of movement in the course of six weeks.

In another case which I saw at the same hospital the patient had been suddenly seized about a year previously with paralysis of the right leg, which gradually extended to the right arm. The right arm and leg were parietic, but the face was unaffected. Sensibility and electrical reactions were normal. He stated the attack had come on suddenly, with partial loss of consciousness and pain in the left side of the head, during sexual intercourse. The pain in the head had, according to the patient's account, quite disappeared, but, on percussion of the skull, pain was elicited above the left parietal eminence close to the middle line. This would correspond with a lesion affecting the posterior and upper border of the fissure of Rolando, which would account for the symptoms. The lesion was probably superficial hæmorrhage.

Last May I was consulted in reference to a patient who, four months previously while playing at cards, had been suddenly seized with speechlessness and slight paresis of the right arm. After three days speech had returned, but was rather unintelligible, and he did not seem to understand what was said to him. He recovered to some extent, but had a similar attack while playing at bowls three months after the first. This time he complained of pain in the head, and he gradually passed into the state in which I found him.

He had no paralysis. He could articulate fairly well, and read; but he seemed utterly unable to comprehend what was said to him, except such simple things as "stand," "sit down," &c. He looked utterly bewildered when asked such questions as, Whether he had any pain in the head? He could understand gestures, and could make out the meaning of what was written for him on a slate which he kept for the purpose. He had

long been deaf in the left ear, but he could hear distinctly with the right. In short, the symptoms were typical of "surditas verbalis," or "word-deafness." He had a systolic murmur, both at apex and base, and a well-marked diastolic murmur, with the pulse of aortic regurgitation.

He complained of no pain in the head, but on percussion pain was elicited in the left parietal region below the parietal eminence. The symptoms in this case would be accounted for by a lesion affecting the superior temporo-sphenoidal convolution and margins of the fissure of Sylvius, and the situation of the painful area would correspond with a lesion so situated. The case therefore is like one reported by Wernicke, in which a lesion was found in this part of the cortex after death.

The lesion was probably embolic, as the age of the patient (38), the absence of syphilis, the mode of onset, and the presence of extensive valvular disease would indicate.

This patient recently died with cardiac symptoms, but unfortunately a post-mortem examination could not be made. Dr. Parsons of Liverpool, under whose care the patient was, informs me that the pain in the neighbourhood of the left parietal eminence could always be elicited up to two months before death.

I had under my care at King's College Hospital a patient whose chief symptoms were a staggering and uncertain gait, which had come on after a fit in which he had temporarily lost consciousness. The staggering was especially observable when the patient was made to wheel to the right, less so when he wheeled to the left. The symptoms gradually disappeared, the last sign of the unsteadiness being the inability to hop round on the right foot, while he could do this easily on the left.

In this case there was marked pain on percussion in the right occipital region. From this, as well as from the peculiar symptoms, I diagnosed lesion of the right cerebellar lobe, probably due to cerebellar hæmorrhage of limited extent, which became absorbed. The pain in the right occipital region disappeared with recovery from the other symptoms.

I have at present under my care a patient who staggers much when walking, and who cannot stand when the feet

are placed close together. On attempting to do this he invariably falls backwards. The symptoms are not intensified appreciably on closure of the eyes, and there is no real ataxy, nor are any of the characteristic symptoms of ataxy present. There is also complete deafness in the left ear, partial paralysis of motion and anæsthesia on the left side of the face, and loss of tactile sensibility and taste on left anterior two-thirds of the tongue. He has occasional pain in the head in the occipital region, with nausea and feeling of sickness, but there is no optic neuritis, though perhaps the veins are somewhat larger than normal. The symptoms point strongly to cerebellar tumour, and pressure on the fifth and seventh cranial nerves of the left side.

In this patient percussion over the left superior curved line of the occiput causes very marked intensification of the headache which he suffers from, but not continually, in the occipital region. The symptoms and the situation of the pain are thus mutually confirmatory of lesion, probably tumour, in the left cerebellar lobe.

In syphilitic lesions of the cortex pain is, as has been stated, often spontaneously complained of, and very frequently in a region corresponding to the position of the disease. This, however, is not always so. If it exists, it is intensified by percussion, but percussion may serve to elicit it when it is not otherwise perceptible.

Dr. Robertson has recorded a case ('Brit. Med. Journal,' May 18, 1878) of syphilitic epilepsy affecting the right side of the body, beginning chiefly in the right hand, and usually without loss of consciousness. The attacks were followed by a greater or less degree of paralysis of the parts affected by the convulsive spasms.

The patient did not spontaneously complain of pain in the head, but on percussion of the skull pain was elicited in a circular area two inches in diameter, the lower margin of which was two inches above the highest point of the ear. As Dr. Robertson remarks, with reason, it is probable that the lesion did not implicate the skull or dura mater, as in such conditions the pain is usually distinct enough, and often severe, especially at night, and not requiring artificial elicitation.

The locality of the pain would confirm the diagnosis of a syphilitic lesion of the cortex in the convolutions bounding the fissure of Rolando.

In a case which I had under my care two years ago there was a syphilitic history, and the patient was subject to repeated attacks of spasm of the right leg, sometimes occurring during walking and causing danger of falling. Frequently the right arm was implicated, and sometimes the right side of the face also. The patient never lost consciousness in his attacks.

He had no pain in the head, but percussion of the skull caused uneasiness when applied over the posterior superior angle of the left parietal bone close to the middle line. This would confirm the diagnosis of a cortical lesion affecting especially the superior parietal lobule. The symptoms were greatly ameliorated under the influence of iodide of potassium, so long as the patient remained under my care, but I can say nothing as to the subsequent progress of the case, as I have lost sight of him.

Last November I was consulted by a patient, aged 25, who had paresis of the left arm. Two years before he had contracted syphilis, and some months before he consulted me he had woken up one morning with numbness and loss of power in the left hand and arm. This gradually diminished, when, three weeks after, he was suddenly seized while walking in the street with paralysis of the left arm and slight staggering. He did not lose his speech, though, as he said, he experienced some difficulty in articulation. He had a headache at the time, and his thoughts were somewhat confused. When I saw him the only indications of symptoms remaining were slight paralysis of motion of the left hand and arm.

There was no cardiac disease, and he had no pain in the head. On percussion of the skull, pain was elicited in the middle of the right parietal region, just anterior to the parietal eminence.

Under the influence of iodide of potassium the paresis disappeared in the course of six weeks, and the pain on percussion of the right parietal region was no longer felt.

The locality of the pain, taken with the symptoms, indicated lesion in the ascending parietal convolution, and the rapid

disappearance of the symptoms under specific treatment justified the diagnosis of a syphilitic affection of the cortex.

I have at present under my care a patient, a girl aged 8 years, whose history and symptoms indicate that a tubercular affection of the cortex may exist without causing headache, which, however, may be elicited by percussion of the skull.

This patient belongs to a family, two of which have died in infancy with all the symptoms of tubercular meningitis. A younger sister has a very large head with bulging forehead, and the usual appearances of the strumous diathesis.

She has been subject to recurrent fits, in which the prominent symptoms, described by her mother, are a remarkable turning of her head and eyes to the left. She does not fall, and there does not appear to be complete loss of consciousness during her fit. The left arm is paretic, the grasp feeble, and there is some rigidity of the flexors of left hand. The face is slightly drawn to the right when she grins. The left leg seems as strong as the right, though her mother says it was at one time distinctly weak. Sensation and electric contractibility are normal. She has usually no pain in the head or nausea, though at the period of attacks she has some pain in the head and a tendency to sickness. The optic discs are sharp and present no abnormal appearance.

On percussion of the skull she indicates a spot in which pain is felt, situated about an inch and a half from the sagittal suture in a line drawn vertically upwards from the external auditory meatus.

The symptoms in this case, taken with the general history, seem to point to a tubercular affection of the cortex; and they would be capable of explanation by a lesion situated in the upper half of the ascending frontal convolution and junction of the upper and middle frontal.

The position of the percussion pain would correspond very closely with a lesion so situated.

I freely admit that in the absence of post-mortem confirmation these various facts do not altogether satisfactorily establish a correspondence between the locality of the percussion pain and the cerebral lesion. I have not, however, had

an opportunity of post-mortem examination in cases which I have carefully examined in this way.

But it appears to me a fact of very great significance and corroboration of regional diagnosis otherwise arrived at, that percussion of the skull so often elicited pain over the region where the lesion was localised. If the correspondence cannot as yet be regarded as conclusively proved, yet I think the facts warrant a more general adoption of percussion of the head in the localisation of cerebral disease with the view of testing its value over a much wider range of clinical and pathological observation than can possibly occur to any one individual.

A CASE OF PECULIAR AFFECTION OF SPEECH, WITH COMMENTARY.

BY W. H. BROADBENT, M.D., F.R.C.P.,

Physician to St. Mary's Hospital.

THIS paper was so far written before Dr. Hughlings-Jackson's article "On Affections of Speech from Brain Disease" came into my hands, that to take advantage of it and discuss points in which we appear to differ would necessitate its entire reconstruction. It is, moreover, simply a *mémoire pour servir*, and does not pretend to give a complete account of the relations of derangements of speech with lesions in the brain, but presents the question from a particular point of view. This, it is hoped, will explain and excuse the absence of reference to the work of Jackson, Bastian, Ogle, and others, in the same field, the value of which to science, and its instructiveness to myself, I shall always be forward to acknowledge. The patient, a well-educated and intelligent young man, was admitted under the care of Dr. Sieveking, Jan. 18, 1878.

Eight years previously he had contracted syphilis, and suffered from secondary manifestations of this disease.

For a year he had noticed that wine had an unusual effect upon him, a single glass making him feel intoxicated, and he had had occasional seizures, during which he lost his sight and almost consciousness; his limbs trembled, and he had to grasp something to prevent himself from falling. These fits of *petit mal* lasted from two to five minutes.

About a fortnight before his admission he was suddenly seized with right hemiplegia and loss of speech. It was stated by the friend who brought him that this had come on

during the night; but he subsequently explained, in a fragmentary manner, that the attack occurred during the evening, that, a quarter of an hour before, he had been quite well and was smoking; he put down his cigar, and suddenly lost the use of the right limbs.

On admission he could walk in a tottering way, could move the right arm vaguely, hold a pen in his hand, but could not write. He appeared to understand all that was said to him, but was unable to answer questions—he tried, but failed; said “Yes, yes, yes,” and would wave his hand. He tried to write with the left hand, but could not; he produced a letter he had written before the attack to show that he had been able to write.

There was no deviation of the tongue when it was protruded, and he could whistle well, the mouth, however, going slightly to the left.

He improved in all respects, recovering power in the right arm and hand, walking better, and acquiring words. On January 29th he could say his own name, and write it with effort. When asked how he was, he would answer “Yes, yes, very much better,” but was capable of little beyond this. Said “yes” on all occasions; in trying unsuccessfully to answer a question would say “Yes—the—Eh! Yes! Yes! Oh gracious me! Yes.”

Still unable to read or write.

Dr. Sieveking called my attention to the case, on February 26th, as one presenting peculiarities, and kindly gave me permission to study and make use of it. By this time the arm and hand had nearly recovered their normal mobility and power, but the leg was carried stiffly, causing the walk to be slow and clumsy. There was no obvious deviation of the tongue on protrusion, or inequality of the two sides of the face.

He remained under observation in the hospital till near the end of March, and was last seen on April the 2nd. The following particulars are summarised from notes made during this period, gradual improvement taking place, but not to such a degree as to cause any essential change in his condition.

He appeared to understand all that was said.

He replied to questions requiring brief and simple answers

readily and distinctly, saying, for instance, "Very much better," when asked how he was, and varying the phrase; or, "Oh yes, perfectly," when asked if he understood what he was reading. He would also, when embarrassed in endeavouring to express himself, interpolate the phrase, "but I can speak very much better than I could."

He was unable, however, to give a connected account of anything requiring more than a few words. His method of correcting the statement which had been made to us that he woke up from sleep paralysed and speechless, was somewhat as follows: "No—evening, evening—put down my cigar—smoking, smoking not quarter of an hour—all at once"—indicating by gestures the loss of power in the limbs, and adding—"Couldn't speak."

Again, wishing to inform me that he had heard from a brother in America, to whom a friend had written respecting his attack, he came up to me, fumbling in his pocket for a letter (not the one from his brother, as he told me on inquiry), and saying "Brother—brother—'Merica—letter—New York—two brothers in America." It was only by questions based on hints afforded by such fragments of phrases that his story was elicited. One of the brothers was a dentist in New York. He was unable to recall the word dentist, but said "Doctor—Doctor;" indicating, however, that he was not exactly the same kind of doctor as myself, and getting out of his difficulty at length by tapping his teeth. When I said the word "dentist" he assented, and repeated it after me. Another brother was apparently in Pernambuco; he corroborated my guess that this was the place he was endeavouring to name, but was never able to say this longish word.

At first he had lost all notion of numbers, and could not tell how many 2 and 2 made; but by practice he could on February the 8th add together two low figures, and was beginning to learn the multiplication table. On the 26th he could multiply by 2 and 3 up to 12, but he could not tell what 5×5 gave. He could show the numbers up to 10 on his fingers, but not 25.

When the table, a glass, an inkstand, violets were pointed out to him, and he was asked to name them, he was unable to

do so. When last seen, April 2nd, he could not name his gloves, or hat, or a pen. He named some objects—his hand, the fire, &c.; and when he had been tested with regard to any particular thing, he would usually be prepared with its name on a subsequent visit. He was rarely able to give Dr. Sieveking's name, when asked what physician he was under.

He said he spoke French, and, when tested, did so with an excellent accent; but in trying to say that he had lived in Paris as a boy and gone all over France, he betook himself to English.

Up to this point there is nothing very remarkable in the case. The peculiar and interesting feature was developed when he was made to read aloud. He perused his newspaper regularly, and with all the marks of intelligent interest. He understood it also, for he went to the sister in a state of great excitement to tell her of the failure of a firm with which he had business relations, carrying the paper in his hand, and pointing out the announcement; and he could always find a given paragraph when asked to do so as a test. When, however, he was asked to read aloud, the result was gibberish. The following passage was selected: "You may receive a report from other sources of a supposed attack on a British Consul-General. The affair, however, is utterly unworthy of consideration. No outrage was even intended, and the report is due to misrepresentation of the facts. The Odessa line is again working properly." It was read slowly, and in a jerky manner, as nearly as it could be taken down thus: "So sur wisjee coz wenement ap ripsy fro fruz fënement wiz ā seconce coz foz no Sophias ā thee freckled pothy conollied. This affaise eh oh cont oh curly of consequences. Uce sudos val oh es es entain ah thee enepol ā oh dee ā ah messequence oh coz foz. The assoil lens ā puff piff miss corres povety."

It will be seen that there is no traceable relation between the passage and his rendering of it beyond a certain imperfect correspondence between the number and length of the words, obscured by the difficulty of determining whether some of the sounds represented words or interjections thrown in when he was perplexed. Unfortunately he was not made to read the same passage twice or three times, his attempts being taken

down in writing, but it was clear that there was no regularity in the substitution of certain constant inappropriate sounds for given combinations of letters.

It was evidently an effort to read aloud, requiring close attention, and he read seriously and steadily, apparently unconscious of the absurdity of his utterances (probably because he was too intent on his task), till interrupted by laughter which it was impossible to restrain, in which he usually joined.

He was never able to give the simplest written answer to a question or to write from dictation, but he signed his name quite well, and wrote down the names of his brothers, but with the initial only of the Christian name, the surname in full. He wrote T. for Tom, but could not write Tom, though habitually saying it. He could not give his address in writing.

When asked to copy a sentence, he wrote the short words quickly and in a good hand, but a long word he took down slowly, letter by letter, in large schoolboy characters, usually accurately; but as he wrote each letter he named it aloud, and *always wrongly*. He always, however, gave it the name of some letter or other, and not a name of his own invention.

At first sight it seems impossible to realise the mental condition in a case such as this, or to specify the derangement in the mechanism of speech and thought which gave rise to the extraordinary perversion in the translation of printed words into sounds; but cases have been observed which appear to throw, at any rate, some light upon the phenomena.

It will be well, in the first instance, to estimate as nearly as possible the general intellectual damage. This appeared to be very slight. The patient understood all that was said to him, conducted himself rationally, appeared to have perfect recollection of his past life and occupation, displayed an intelligent interest in all that was going on around him, in his own case and in our inquiries into it, and showed much ingenuity in contending against the difficulty in expressing himself occasioned by his loss of memory for words. He appeared, however, to have lost the idea of number to a very considerable extent; he could not at first have added 6 and 5, or told what twice 6 made; and when he had mastered the first two

lines of the multiplication table, he was still unable to say what 5 times 5 gave. Possibly this might arise from failure to realise the number indicated by its name, or to recall the name of a number, and be an example of his loss of this memory for names. Unfortunately he was not tested by concrete illustrations, as by being made to give change for or out of a sovereign. He was unable, however, as already stated, to show on his fingers numbers above 10.

The difficulties in expressing himself in words seem to be capable of resolution into the following factors.

1. *Ideas no longer evoked in the mind the words necessary for their expression.*—So far as this went, it was a loss of memory for words, and not the loss of the memory how to say words; if the words were supplied, or merely suggested, the patient made use of them at once. In this respect, therefore, the case was distinguishable from one of aphasia proper, in which phrases or words dictated cannot be repeated. It was not however, simply a loss of the memory of names or of the power of naming. In a spoken sentence there are two distinct factors, the names, and the other parts of speech which bring the names into some relation with each other (a proposition consists of a subject and a predicate); the names alone are intellectual symbols of external objects or of concepts; the predication in which the other words are employed is an intellectual operation. Now in some instances of loss of memory of words the difficulty arises entirely from the impossibility of recalling to mind names (a condition which might be called simple amnesia had not this term through vague employment lost all definite meaning). Such was not quite the case here; the patient had difficulty in remembering names, but often when he appeared to have the names in his mind, as for example, "brother," "New York," "America," he could not construct the sentence.

2. There was therefore also a defect of "intellectual expression," that is, in the efferent department of the cerebral mechanism of speech, but anterior to that which constitutes simple aphasia. An aphasic may propositionise in consciousness, may mentally rehearse a sentence but be unable to utter it; the patient here was obviously unable to construct a

sentence in his mind, but once present to his mind it was promptly spoken.

3. *The sight of an object no longer recalled its name.*—This might be looked upon as simply a particular case of the general defect of memory for names which existed here. But the faculty of naming objects at sight (the automatic suggestion of the name by a visual impression), may be absolutely lost, while there is little or no impairment of the power of recollecting names or other words.¹ A case is reported by me in vol. lv. (1872) of the 'Medico-Chirurgical Transactions,' in which a man who talked fluently and well, and was scarcely ever at a loss for a word of any kind, could not name the most familiar object shown to him. He could not give the name of a single letter and could not therefore read; he could, however, write correctly, either from dictation or spontaneously, but he was absolutely unable to read what he had himself written.

4. There was absolute loss of the faculty of translating auditory symbols (spoken words) into visual or graphic symbols, and of the power of graphic expression, *i.e.* he was completely agraphic; could neither write from dictation nor spontaneously, though he could copy and render printed into current characters.

5. While he understood visual or graphic symbols he could not render them by the appropriate verbal symbols.

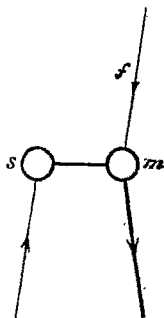
It is no explanation of cases such as this to invent names more or less expressive of the derangements observed, or to describe them in psychological terminology. What is wanted is that the damage in the cell and fibre mechanism of speech, and of the mental operations concerned in speech, shall be specified. This mechanism is, however, yet unknown: a few important portions of it are identified, but that is all which can be said.

In attempting to construct this mechanism hypothetically, the basis must be such facts of structure as are known, together with experimental and clinical localisation of functions; and

¹ The converse, however, of this—absolute loss of the power of calling to mind names while the name is at once suggested by the sight of the object—is not known to me.

the scheme must be consistent with the mode of nervous structure and operations as exhibited in the simple forms of nervous apparatus.

We have throughout the nervous system a receptive and emissive department, which may be called, for convenience, sensory and motor respectively. The relations between these two divisions, and between higher and lower nerve-centres, as exhibited where they are simplest and most easily followed, viz. in the spinal cord, will furnish a guide to the higher and more complex relations. Now all muscular movements are performed under the direction of a "guiding sensation." The precision of action of the limbs would be impossible without the controlling influence of sensation in the parts set in motion. Structurally this would be represented by saying that the motor cells of the anterior nerve-roots concerned in the execution of a given movement are originally selected and combined through the sensory cells of the posterior nerve-roots. For each movement there is employed a certain definite group of motor nerve-cells in the cord; the education of the cord for a given movement would be the association by processes of the cells forming its group; and this is effected under the influence of guiding sensations from the limb, *i.e.* through the sensory cells in the posterior grey columns. The motor cell-group constituted in this way is then ready for employment by a higher centre. A diagram may assist in rendering



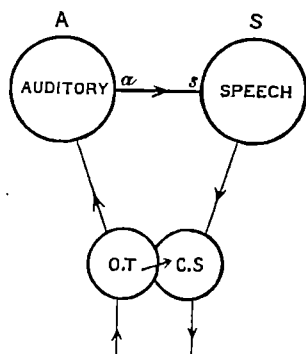
this idea more clear. *s* is a group of sensory cells, which receives the guiding impressions from the periphery, and under its influence is arranged the group of motor cells *m*,

which call into action the requisite muscles; *f* is a bundle of fibres, from a higher centre which employs the motor group *m*. This is representative of the entire process of motor education. A motor cell-group is formed under the guidance of a sensory cell-group on the same level, and, when formed, is made use of by a higher centre; this higher centre having, so to speak, been the exciting cause of the process. An infant in the dawn of its intelligence desires to use its hands to grasp an object and carry it to its mouth, this is the stimulus from the higher centre; the gradual acquisition of precision in the required movements is the association of the appropriate motor-cells in the cord for combined action, which is effected through guiding sensations from the hands and arms, transmitted of course to the sensory cells, and by these to the motor-cells. (We may parry the objection that sight is the guiding sensation, by supposing the child employed in the illustration to be blind.)

In the case of words, there will be somewhere or other in the higher centres a set of motor nerve-cells, from which will descend fibres to the nerve-nuclei of the thoracic muscles for the production of an expiratory current of air; others to the larynx for phonation; others, again, to the tongue and lips for articulation. The set of cells called into action in the utterance of a given word will constitute what I have elsewhere called a "word-group," and I have hypothetically located such word-groups in the corpus striatum, where they would be formed or linked together under the guidance of auditory sensory impressions, reaching the corpus striatum through the thalamus. The word-groups in this ganglion would be simply motor combinations, quite irrespective of the use of words in language, intellectual and emotional; they would, in fact, be exactly on the same level as the words learnt by a parrot. I am no longer, however, quite so confident that the corpus striatum is the indispensable intermediary between the hemisphere and the cord, since cases are on record in which both divisions have been destroyed or greatly damaged without the hemiplegia, which would be inevitable were this the case. This, however, would only shift the seat of the primary word-groups to the third left frontal convolution, without making any other difference in the plan

of the mechanism of speech, which I advance by way of provisional hypothesis.

Ascending to the hemispheres, it will be simply assumed without argument that the third left frontal convolution is the "way out" for intellectual expression by speech, for words in relation to ideas. This is not simply because the third frontal convolution is the convolutional motor centre for the lips and tongue, since we constantly see aphasia without right facial hemi or monoplegia, and conversely right facial hemi or monoplegia without aphasia. The higher centre which calls into action Broca's convolution we cannot localise. The guiding centre will be the auditory perceptive centre placed by Ferrier in the infra-marginal gyrus of the fissure of Sylvius. The cells of the third frontal will be trained and grouped for the utterance of ideas transmitted to it for expression, by means of cells of the Sylvian infra-marginal, which, as the seat of auditory perception, will have registered words as heard. Now just as the integrity of the nervous apparatus of guiding-sensation is essential to precise and orderly movement, even when the motor cell-groups are organized, so is the due connection between the auditory perceptive centre and the speech-centre essential to precise and orderly utterance. Damage to this relation is the explanation of "mistakes in words." For the sake of clearness we may again resort to a diagram. Lesion



of *s*, the speech-centre, the third left frontal, will give rise to aphasia proper; lesion of *A*, the auditory perceptive centre (infra-marginal Sylvian gyrus), or of *a*, *A* and *s* remaining

intact, would cause "mistakes in words," probably different in kind in the two cases.

Up to this point we have the explanation (hypothetical and provisional) of three forms of affection of speech.

1. In the lesion of S, of simple aphasia, in which the patient understands all that is said to him, and knows what he would like to say in return, but cannot put it into words; the "way out" for words in intellectual expression is broken up. He may say "Yes" and "No," and a conventional word such as "Good-bye" may slip out when occasion arises, or an emotional phrase on excitement, which I have elsewhere supposed to be possible through the existence of primary word-cell-groups in the corpus striatum, which had, by frequent repetition, acquired a secondary reflex association with emotional states. He will be unable to repeat his favourite oath, or his formula of welcome or leave-taking, or perhaps even "Yes" and "No," when bidden to do so.

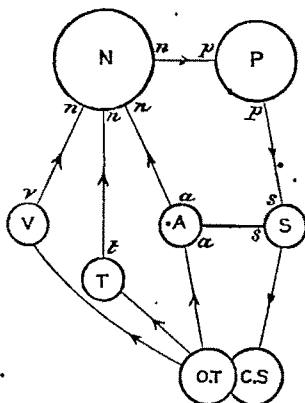
2. By lesion of the line of communication as the explanation of mistakes in words recognised by the patient.

3. In lesion of A of mistakes of which the speaker remains altogether unconscious.

There are higher centres, however, than those with which we have been occupied, and we may consider the part they play in the function of language, and the disorders which lesion of them may produce, before we refer to the complications introduced by reading on the one hand and writing on the other.

The formation of an idea of any external object is the combination of the evidence respecting it received through all the senses; for the employment of this idea in intellectual operations it must be associated with and symbolised by a name. The structural arrangement corresponding to this process I have supposed to consist in the convergence from all the "perceptive centres" of tracts of fibres to a convolutional area (not identified), which may be called the "Idea Centre" or "Naming Centre." This will be on the sensory, afferent, or upward side of the nervous system; its correlative motor centre will be the Propositionising Centre, in which names or nouns are set in a framework of other words for outward expression, and in which a proposition is realised in consciousness or men-

tally rehearsed. If we are to have a seat of the faculty of language, it would be here rather than in the third left frontal convolution, with which, however, it may possibly be in close proximity. Expressing this by a diagram, we have *v*, *A*, and



t, the Visual (angular gyrus, Ferrier), Auditory (infra-marginal Sylvian gyrus), and Tactual (uncinate gyrus), perceptive centres sending converging tracts of fibres, *v n*, *a n*, *t n* to *N*, the "naming centre." Here the perceptions from *v* and *t* (smell and taste are omitted for the sake of simplicity) are combined into an idea, which idea is symbolised by the word reaching *N* through *A*, which has always, in the experience of the individual, been associated with the object. *P* is the propositionising centre in which the phrase is formed, its relations with *N* and *S* being sufficiently clear.

It will no doubt be objected that there is no evidence of two centres, one for propositionising, and the other employed by it for utterance; one for the construction and mental rehearsal of a phrase, and the other for realising it in spoken words; and it is unquestionably true that, in a large proportion of cases of aphasia, both faculties are lost. The independence of the two operations seems to me, however, to be established by the following facts: *a*. There are cases in which the patient cannot frame the simplest phrase, but can repeat anything said before him. Here *s* is intact, *p* destroyed. *β*. The converse of this — namely, that a proposition is realised in consciousness, so that not only the wish, but the words, are present to the mind,

while the expression of them is impossible—is difficult to establish; but a comparison of cases of aphasia has led me to the conclusion that such is sometimes the case. If, however, there are really instances in which speech is lost while the power of writing is retained, this would be conclusive. This will be considered later.

This diagram will perhaps bring out clearly, what is, however, well recognised, the distinction between nouns or names and other parts of speech; the receptive centre, *N*, has to do only with names; as soon as other words are brought into use a motor function is exercised. It will further enable us to represent the causation of other derangements of speech, *e.g.*

4. Loss of the memory of names or nouns. Numerous examples are on record; and a very good illustration has lately passed under my observation. An old gentleman, after very slight right hemiplegia, can give long answers fluently and volunteer statements, so long as the phrase does not contain a noun. "Oh yes, I am much better than when you last saw me." "I shall be 73 on the three—four"—when he confused himself in trying to find the word December. He could not name a hand when told to do so, but in his effort something like leg was once heard. This gentleman's memory of facts, events, dates, and faces is very good.

It will be at once seen that lesion of the naming centre, *N*, gives the explanation of the functional loss.

5. Another derangement of speech is where names are more or less remembered, but there is loss of the faculty of constructing a sentence which shall convey the ideas to be expressed regarding them; that is, of the power of framing a proposition. The lesion here will be in the propositionising centre *P*.

This condition is illustrated imperfectly in the case which forms the text of this commentary, as when the patient could only say, "Brother, brother—New York—America—two brothers in America—letter," leaving it to us to fit the words together so as to convey information.

6. Still another derangement of language is one well illustrated by the case to which allusion has already been made, related in my paper "On the Mechanism of Speech and

Thought," in the 'Medico-Chirurgical Trans.' for 1872 (vol. lv.), and dwelt upon also in a communication "On a Case of Amnesia," in the 'Transactions' for 1877-8, that of a man who conversed fluently and wrote correctly, both from dictation and spontaneously, but who was unable to name any object which he saw, or to read a single letter, printed or current, even in what he had himself just written.

The channel of communication between the visual centre, *v*, and the naming centre, *n*, was destroyed. It may be added that the lesion found in this case underlay the angular gyrus in which Ferrier locates the visual perceptive centre.

Traces of a similar loss of the power of naming an object at sight are present in many recorded cases, but it is rarely that the clue has been followed. In the case here related there was impairment of this naming power.

7. Cases in which the auditory perceptive centre *A*, or its communicating tract with the naming centre *a n*, is destroyed. These have been recently considered in the communication to the Medico-Chirurgical Society, already mentioned "On a Case of Amnesia," &c.

If the speculations here pursued are well-founded, and it is claimed for them that they are based upon careful anatomical investigation, and upon the application to the results of this investigation of the localisation of functions by Ferrier, Hitzig, and others, to which the anatomical facts adapt themselves with perfect readiness, it follows that derangement of speech may be caused by lesions in different parts of the cerebral cortex, as has been found on post-mortem examination. In the case of amnesia reported to the Medico-Chirurgical Society, in which there was loss of comprehension of spoken or written language, while the speech was mere gibberish, the lesion lay entirely behind the motor region of the hemisphere as had been prognosticated. Now most of the objections to the functional association of Broca's convolution, with an important link in the mechanism of speech, are based upon the idea that all forms of speech disturbance should be accounted for by changes in this gyrus. This idea has been encouraged by the vague use of the term aphasia, and by employing compounds of this word, such as amnesic aphasia,

ataxic aphasia, paraphasia, &c., to denominate different speech-derangements. It cannot be too strongly urged that different affections of speech indicate damage to different parts of the mechanism of speech, and therefore lesions at different points of the cortex, or white fibres of the hemispheres. In course of time, by careful analysis of derangements of language and speech, and by minute and accurate description of the lesions associated with definite forms of derangement, the localisation of the different cell-areas which enter into the apparatus of speech may be effected. It is probable that the propositionising centre P, and the speech or utterance centre S, are in very close proximity, as they are so commonly affected together; and P, as belonging to the motor department of the cerebrum, would be in the anterior part of the hemisphere; N, on the other hand, being on the reception or sensory side of the nervous apparatus, might be expected to be in the neighbourhood of the perceptive centres. As a provisional guess I have conjectured that S may be in the foot of the ascending frontal (first ascending parietal) gyrus, P in the third left frontal, and that N may be situated in an unnamed lobule (collateral lobule of my paper "On the Structure of the Cerebral Hemisphere"), situate on the under-surface of the temporo-sphenoidal lobe, near its junction with the occipital lobe, as fibres from all the convolutions in which perceptive centres have been placed by Ferrier converge to and end in its grey cortex.

There remain to be considered the complications introduced into the question of language by reading and writing. They are extremely perplexing, and have been arbitrarily excluded from consideration up to the present stage of the discussion, for the sake of simplicity and clearness.

The steps of the educational process by which these arts are acquired are as follows. Reading of course precedes writing, and there will be first the association of visual perceptions, letters or words, with previously familiar sounds, or auditory perceptions; the acquisition of this association is greatly facilitated, and is almost always aided by simultaneous utterance of the sounds at the bidding of the teacher; but this is not absolutely necessary, as children sometimes learn to point out

letters which they cannot be persuaded to name. This process will be represented in the diagram by bringing into use fibres connecting the auditory and visual perceptive centres *A* and *V*, and again perhaps by fibres passing between the visual centre *V* and *S*, the speech centre. At first the entire attention is absorbed by organisation of the association-links between these lower centres, and the subject-matter of what is read is altogether neglected. Later, when the association of the visual and auditory perception of words is perfected, and the response of the speech-centre *S* has become automatic, written words convey ideas to the higher centre *N*, and eventually quite as promptly as spoken words. In reading to oneself, the path *V S* may come to be as entirely neglected as the path *A S* in listening. Whether the perceptions are transmitted upwards through *A*, or directly from *V* to *N*, cannot be said. Since, however, it appears from observation of cases of aphasia that visual perceptions of words, printed language, must be realised, or capable of realisation, in consciousness as spoken words in order to be understood, it does not seem probable that an independent path exists between *V* and *N*.

In learning to write, the centre *W*, which will be that for the delicate movements of the hand, is educated through the visual centre *V*; that is, by repeated copying, cell-groups, or cell-groupings, will be organised in *W*, representing written words which can then be employed by the propositionising centre *P* in intellectual expression. There must, however, be a close association between *S* and *W*.

As a rule, aphasia and agraphia go together, and this all but constant association is not explained by any very close proximity of the centres for the lips and tongue to that of the hand, as localised by Ferrier and Hitzig, causing the two to be involved in a common lesion. There may be absolute loss of the power of writing when the lesion is limited to the foot of the ascending frontal and the posterior part of the inferior frontal gyri, quite away from the part of the ascending convolutions in which the hand centre is situated. Either, then, the fact that writing is a form of intellectual expression engrafted upon speech makes one centre, *W*, dependent upon *S*,

or speech, s, and writing, w, are both employed by some higher centre, r, in which ideas are primarily clothed in words. Now writing is sometimes lost when speech is not, or more profoundly affected, as in the case related, and in many others. This would fit in with either hypothesis. If, however, there are cases in which a man can express himself in writing but not in spoken words, the lesion not being in the pons or bulb but in the hemisphere, the second supposition must be the true one. Such a case I have never seen, though I have had a patient in St. Mary's Hospital who could write better than he could speak, whether in answering questions or on dictation—and very few of the examples on record will stand a critical examination. There is no post-mortem evidence on the subject known to me. The case of Dr. Osborne's, quoted by Dr. Bastian,¹ seems at first sight to be an instance; and as it has points of resemblance with the case here related, a brief summary of it may be given. The patient, a well-educated man, understood all he heard and read; had lost none of his mental power; could construe Latin and Greek, and work out mathematical problems; and, finally, *could write fluently*; his speech, however, was absolutely unintelligible; and when he was made to read aloud, it was pure gibberish, except that such words as "in the," "to," and "as," were often correctly given. Here the lesion was obviously not bulbar but in the hemisphere, and there is clear evidence of derangement of articulate expression; while there was no corresponding impairment of the power of expressing ideas in writing, which would seem to furnish the proof required of independent centres for speech and writing. My explanation, however, of the phenomena is that the speech centre was cut off from its guiding influence, the auditory perceptive centre, and not that the speech centre itself was damaged, *i.e.* the tract A S was destroyed.

It has been necessary to explain the provisional hypothesis of the mechanism of speech which has grown up in my mind, but it is not attempted to do more than give a sketch of it, and we may now apply it to the case under consideration.

In the first place the speech centre s was undamaged

¹ "On the Various Forms of Loss of Speech." 'Medico-Chirurgical Review' for 1869.

When words occurred to the patient's mind, or were spoken before him, he could utter them without difficulty.

The propositionising centre, however, was affected: he was unable to frame any but the most simple phrases, even when the nouns were supplied, and he knew well what information he wished to convey.

Writing was entirely lost. He could copy, though with difficulty. Could sign his name and write down the names of his brothers, but with the initials only of the Christian names. He could not answer the simplest question in writing, even when "yes" or "no" only was required. Could not write a single word from dictation, and could not even write "Tom," which he told me was the name of one of his brothers, though he wrote the initial.

It is easy to see that the agraphia depended upon failure to realise mentally written words, or to call up a pictorial representation of them, which is a necessary antecedent to their reproduction in writing. This was evident from what was observed when he was made to copy; such words as "it," "the," "and" &c., which he could carry in the mind for the requisite time, he wrote rapidly and in a good hand; while longer words were taken down slowly, letter by letter (each one misnamed aloud) and in awkward schoolboy characters. As mental pictorial representations will be reproduced where they were originally engraved by perception of the words as external objects, we trace the derangement to the visual perceptive centre, which will be seen to be the starting-point of other derangements. We must stop for a moment, however, to remark upon the contrasts between this case and one of those so frequently mentioned in this communication, that in which a man had lost, absolutely and entirely, the power of naming an object at sight and of reading, while he could not only talk fluently but write quickly and well. The present patient, who had also lost in a great measure the power of giving names to objects seen, could, however, understand what he read, but, on the other hand, could not write. These differences, perplexing at first sight, are easily explained. In the first case the visual centre was uninjured and was in communication with the writing centre, while it was cut off from the naming centre (it

may again be mentioned that on post-mortem examination of this case the angular gyrus was healthy, but the white substance of the centrum ovale immediately subjacent was softened); in the present case the visual perceptive centre itself is damaged and all operations in which it takes part are impaired.

There is a further interest in the analysis of this agraphia, as it furnishes a kind of parallel to some cases of aphasia; the patient could frame a simple proposition in words, but could not express it in writing. We have in this proof that words as *intellectual symbols*, i.e. as vehicles of ideas, may be present to the mind while it is impossible to call up words as *visual symbols*, as groups of printed or written characters (the term "symbols" is used here advisedly, in order to bring out the double sense in which it is employed). In the same way we may have present to the mind ideas and words in which they could be expressed, but not words as sounds.

Returning to the analysis of the phenomena presented by this case, it is evident that the naming centre was affected, and that the difficulty of recalling nouns was not simply the fault of the visual centre. The patient was frequently at a loss for words (nouns), and had to resort to pantomime or circuitous expressions; and it will be remembered that there may be perfect readiness in conversation when the name of the most familiar object is not recalled by the sight of it.

There remains to be considered the extraordinary perversion of speech which resulted when the patient was made to read aloud. This was clearly not due to any affection of the speech centre itself, or to derangement of the downward communication to it from the propositionising centre. In reading aloud there is a double operation, the apprehension of the meaning of what is read—in other words, the transmission upwards of the visual perceptions of words to the centre in which they are translated into ideas—and the translation of printed into spoken language, i.e. the revival in consciousness of the auditory symbols corresponding to the visual symbols, and the utterance of the former. Clearly the bungle took place in the realisation of words as auditory symbols, when presented as printed characters, which ought to be an automatic operation, and the injury

done must have been to the association between the visual and auditory perceptive centres, probably from mischief in the visual centre itself, since there were other evidences of its functional derangement.

I should localise the lesion in this case with some degree of confidence. The history shows the disease to have been syphilitic, and its result was no doubt closure of the middle cerebral artery. The mode of access seems to indicate that at first the main vessel was occluded; but the degree of recovery shows that circulation was re-established in the branches to the corpus striatum, the third frontal, and the anterior extremity of the temporo-sphenoidal lobe, which are given off in the first part of its course. The persistent impairment of function was chiefly in the area of the branches which issue from the posterior part of the fissure of Sylvius to supply the supra-marginal and postero-parietal lobules, the angular gyrus, the posterior part of the infra-marginal and parallel gyri and the collateral lobule of the temporo-sphenoidal lobe. Whether the artery was blocked before these branches arise from it, or each one of them was separately involved in a small gummatous growth as it emerged from the Sylvian fissure (as I have sometimes seen), cannot be stated definitely. The lesion does not appear to have amounted to complete softening.

ON THE WEIGHT OF THE BRAIN AND ITS COMPONENT PARTS IN THE INSANE.

BY J. ORICHTON-BROWNE, M.D., F.R.S.E.,

Lord Chancellor's Visitor.

Two very able papers on the weight of the Brain in the Insane, by my former colleague Mr. Crochley Clapham, which appeared in the third and sixth volumes of 'The West Riding Asylum Medical Reports,' have set forth the results obtained by the weighing of the brains of 1200 insane patients. The observations upon which these papers were founded were begun by me in 1867, and made under my direction and supervision in the post-mortem theatre of the West Riding Asylum, and were part of the general system of examination which was there carried out in all cases of autopsy. They were not intended to afford assistance in any particular line of inquiry, nor to clear up any special obscure points in cerebral physiology or pathology, and they were therefore, though accurate in character, restricted in extent, and did not embrace many details about which it is important to obtain information. Mr. Clapham was therefore only able to deal with the weight of the brain as a whole, and with that of the cerebellum, pons Varolii and medulla oblongata, taken together, in the sexes at different ages and in the various forms of mental disease, and could not enter more minutely into the relative weights of the several component parts of the encephalon. But in 1873 I introduced a method of examining the brain more complete than that which had been previously in use, and this provided records of the weight of the hemispheres, and of the cerebellum, pons Varolii and medulla oblongata separately, besides securing observations upon several other matters connected with

brain structure and function in health and disease, to which it is not here necessary to advert. I proposed to carry on observations under this method for a long series of years and to generalise only when I had accumulated an amount of material which would obviate the fallacies which attend inductions on narrow bases and give authoritative value to my conclusions. But my intentions were frustrated, and my observations cut short, by my removal from the West Riding Asylum in 1876, when I had examined only 400 brains in the more special manner to which I have referred. Although, however, my original scheme was thus baffled, and my anticipated wealth of facts arrested prematurely in its growth, I had still, when my labours were interrupted, collected a store of observations which seemed worthy of sifting and arrangement. Some of these observations, thus treated, are presented in the following pages, and it is believed that, although they are confessedly scanty and incomplete, they will yet afford some useful information, correct some prevalent errors, and guide to further research. In submitting them, however, in the full belief that they are not mere cumbersome additions to pathological statistics, but profitable acquisitions to our knowledge of the brain, I would wish to guard myself against being supposed to claim implicit confidence for all the conclusions which they may seem to warrant. Some of the conclusions to which they conduct may, I believe, be taken as established, standing out so boldly and being founded upon such a breadth of facts, that there is no likelihood of their being upset by any further investigation that may hereafter be undertaken. But others again are only of a tentative or provisional character, and are planted upon so meagre a groundwork of facts, that they may be at any time overthrown or modified; even, however, when conclusions of the latter class are swept away, the figures which have seemed to justify them for a season will remain, and lend themselves to impart a higher accuracy to the new conclusions which more extended experience may suggest.

The tables in which my observations are summarised and arranged will not be accompanied by any elaborate commentary, and yet it will be impossible to leave them altogether to speak for themselves, as certain explanations are essential

to their just interpretation. Attention will be called to the most important results to which they lead, and to some points of interest which they raise, and their bearing upon modern theories respecting cerebral function will be occasionally indicated, but no attempt will be made to constitute them the starting-point of fresh speculations. In some instances the results exhibited in the tables will be compared with the results of other observers; but it is to be borne in mind that this paper does not profess to be an exhaustive review of all that has been written on the weight of the brain in the insane. Far less does it essay to embrace a survey of the literature bearing upon the dimensions of the human brain in the sane. Its motive is to record some new facts, and old facts will be reproduced only sparingly.

As has been already intimated, the results which are set forth in the following tables have been derived from an examination of the brains of 400 insane patients who died in the West Riding Asylum, in a period of the three years, from the 1st of May, 1873, to the 1st of May, 1876. Of these patients 244 were males and 156 were females. The causes of death were of the most varied description, but in a large majority of the cases cerebral degeneration of one kind or another was responsible for the fatal issue. Cases, however, in which tumours of the brain or recent extravasations of blood existed were not included in the investigation. In all cases the brain was examined in a precisely similar manner. Being removed from the skull in the usual way (always by a competent pathologist, and never by a porter or assistant), it was laid in a small trough, while a few rents were made in the pia mater, and a couple of incisions in the corpus callosum, so that the serous fluid which in chronic lunatics is so often found in large quantity, in the ventricles and sulci of the frontal and parietal lobes, might drain away. This fluid having been collected and measured, the brain was weighed as a whole with standard weights, and in scales that were tested and adjusted from time to time. As the next step the brain was placed upon a board, resting on its upper surface, and the cerebellum being raised in the left hand of the operator, two clean cuts were made with a large brain-knife, through the crura cerebri, close to the pons

Varolii. These cuts commenced at the outer margin of each crus, were directed parallel to the anterior margin of the pons, and met in the locus perforatus posticus. The hemispheres being then turned over, were separated from each other by one long sweep of the knife in the central line of the corpus callosum. Each hemisphere was carefully weighed, as were consequently the cerebellum, pons Varolii, and medulla oblongata, which were divided from each other by incisions through the middle peduncles, and in the depression below the inferior border of the pons Varolii. The anatomical landmarks, guiding the incisions enumerated, are so well defined that no serious deviation was possible, and the only instance in which any doubt could be entertained as to the complete identity of the part weighed was in the case of the medulla oblongata. There may have been some latitude in determining the lower boundary of this body, which is on a level with the upper border of the atlas; but pains were always taken to hit upon it as nearly as possible, and it is believed therefore that upon the whole the weight of the medulla oblongata has been correctly given. As regards the hemispheres, cerebellum, and pons Varolii, entire confidence is felt that these parts have been accurately partitioned and weighed.

The general results of my observations are summarised in Table I. (p. 508), in which the average weights are given for all ages and for each decennial period of life, and are set forth in Table II. (p. 509) in a manner rendering more conspicuous and intelligible the average relative weights of the component parts of the brain to the total weight. I have not thought it desirable to complicate Table I. by inserting in it the maximum and minimum weight of the brain at different ages; as, although a certain interest attaches to the range of variation, it is with average results and not exceptional instances that science is concerned.

The weight of the whole brain, as given in Table I., is considerably less than that given in the tables of Mr. Clapham, which were also compiled from the post-mortem records of the West Riding Asylum. In Table I. the whole brain—that is to say the cerebral hemispheres, cerebellum, pons Varolii and medulla oblongata—is represented as weighing,

TABLE I.

TABLE showing the AVERAGE WEIGHT of the BRAIN and its COMPONENT PARTS, at all Ages and during different decades of Life, in 400 Cases of both Sexes.

Ages.	Number of Cases.	Whole Brain.	Right Hemisphere.	Left Hemisphere.	Cerebellum.	Pons Varolli.	Medulla Oblongata.
		Grammes.	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.
All Ages .	M. 244	1334.7	580.7	577.0	151.4	18.7	6.9
	F. 156	1198.5	521.1	519.0	135.7	16.4	6.3
	T. 400	1281.6	557.4	554.4	145.8	17.8	6.7
Under 20 .	M. 8	1336.7	590.5	582.0	141.8	15.8	6.6
	F. 3	1105.4	481.4	460.0	140.0	17.8	6.7
	T. 11	1278.6	560.8	548.7	141.8	16.2	6.6
20-30 .	M. 23	1371.7	601.6	597.0	147.7	18.4	7.0
	F. 10	1201.8	528.2	516.6	135.0	15.8	6.2
	T. 33	1320.2	579.8	572.7	143.8	17.6	6.8
30-40 .	M. 52	1319.5	572.6	568.7	152.8	18.4	7.0
	F. 42	1208.3	524.5	522.1	139.0	16.8	6.4
	T. 94	1269.8	551.2	547.9	146.6	17.4	6.7
40-50 .	M. 55	1321.1	578.2	568.4	153.9	18.6	7.0
	F. 30	1194.0	517.8	517.4	137.1	16.1	6.1
	T. 85	1276.2	553.4	550.4	148.0	17.7	6.7
50-60 .	M. 47	1333.8	578.2	578.7	150.8	19.2	6.9
	F. 30	1218.5	526.1	527.1	137.8	16.8	6.7
	T. 77	1286.9	557.9	558.6	145.5	18.1	6.8
60-70 .	M. 43	1339.8	583.2	578.9	151.7	19.1	6.9
	F. 24	1185.3	517.3	516.3	129.3	16.3	6.1
	T. 67	1284.5	559.6	556.5	143.7	18.1	6.6
70 and up-wards .	M. 16	1365.3	598.9	591.4	148.9	19.4	6.7
	F. 17	1188.8	517.8	515.5	131.4	18.1	6.0
	T. 33	1274.4	557.2	552.8	139.9	18.7	6.3

TABLE II.

TABLE showing the AVERAGE RELATIVE WEIGHTS of the COMPONENT PARTS of the BRAIN to its TOTAL WEIGHT (assumed in each case to be 1000 grammes), at all Ages and during different decades of Life, in 400 Cases.

Ages.	Whole Brain.	Right Hemisphere.	Left Hemisphere.	Cerebellum.	Pons Varoli.	Medulla Oblongata.	Ages.
	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.	
All Ages	M. 1000	435.1	432.3	113.4	14.0	5.2	All Ages.
	F. 1000	434.8	433.0	113.2	13.7	5.3	
	T. 1000	434.9	432.6	113.4	13.9	5.2	
Under 20	M. 1000	441.8	435.4	106.1	11.8	4.9	Under 20.
	F. 1000	435.4	416.1	116.7	15.7	6.1	
	T. 1000	440.4	430.8	110.9	12.7	5.2	
20-30.	M. 1000	438.6	435.2	107.7	13.4	5.1	20-30.
	F. 1000	439.5	429.9	112.3	13.1	5.2	
	T. 1000	438.8	433.8	108.9	13.3	5.2	
30-40	M. 1000	434.0	431.0	115.8	13.9	5.3	30-40.
	F. 1000	434.1	432.1	115.0	13.5	5.3	
	T. 1000	434.0	431.5	115.5	13.7	5.3	
40-50	M. 1000	433.9	430.2	116.5	14.1	5.3	40-50.
	F. 1000	433.3	433.3	114.8	13.5	5.1	
	T. 1000	433.6	431.3	116.0	13.9	5.2	
50-60	M. 1000	433.5	433.8	113.1	14.4	5.2	50-60.
	F. 1000	433.5	434.5	113.1	13.4	5.5	
	T. 1000	433.5	434.0	113.1	14.1	5.3	
60-70	M. 1000	435.2	432.1	113.2	14.3	5.2	60-70.
	F. 1000	436.4	435.6	109.1	13.8	5.1	
	T. 1000	435.7	433.2	111.9	14.1	5.1	
70 and upwards	M. 1000	438.6	433.2	109.1	14.2	4.9	70 and upwards.
	F. 1000	435.7	433.6	110.5	15.2	5.0	
	T. 1000	437.2	433.4	109.8	14.7	4.9	

on an average at all ages, 1334·7 grammes in the male, and 1198·5 in the female sex; whereas in Mr. Clapham's tables the whole brain, at all ages, is set down as 1356·0 grammes for the male, and 1230·4 for the female sex. In my tables, therefore, the brain is shown to be on an average of both sexes, 22·2 grammes lighter than in the tables of Mr. Clapham, a difference which is accounted for by the circumstances that the brains on which my statistics are founded were not examined in the same manner with those which are dealt with in Mr. Clapham's tables. The tearing of the pia mater, and the complete division of the hemispheres in the 400 brains with which my figures are concerned, undoubtedly permitted a far freer escape of blood and subarachnoid serosity than could possibly take place in the case of the 1200 brains to which Mr. Clapham's figures refer, which were weighed entire, just as they were removed from the skull, and without being subjected to any treatment calculated to favour the draining away of their fluid contents, or of serous accumulations in the meshes of the pia mater, or in sulci enlarged by wasting of the convolutions. That this is the true explanation of the disparity in the two sets of figures is rendered certain by the fact, that the results of the first weighings of the whole brain in my cases (not those given in the table, which consist of the sum of the several parts separately weighed) but those which were obtained by weighing the brains in the entire state immediately after its extrication from its bony case, and which it has not been thought expedient to introduce into the table, as their presence there might lead to confusion, approximate very closely to Mr. Clapham's results. A brain that has been taken out of the skull and submitted to slicing, will rapidly part with its fluids, and very diverse opinions might be formed as to its weight, according to the length of time that had elapsed between its removal from the skull and its being placed in the scales. In all inquiries as to brain weight that are intended to have a comparative value, great care must be taken that the brains examined are all treated in a precisely similar fashion.

On comparing the weights of the brain as determined by my investigations with the results of an extensive series of weighings of the brains of lunatics conducted by Dr. Boyd in

the Somerset County Asylum, I find that they are in close agreement. Unfortunately Dr. Boyd has given no general summary of his results, but I have supplied this omission, and find that in all decades of life our results are almost identical. My results also agree generally with those of the late Dr. Thurman, who published the observations made on the weight of the brain in 470 patients—257 males and 213 females—who died under his care in the Wilts County Asylum. I place our results for all ages side by side. Dr. Boyd's observations are stated in ounces, which I have reduced to grammes.

	Dr. Crichton-Browne's Results.	Dr. Boyd's Results.	Dr. Thurman's Results.
All ages	M. 1334.7	1327.9	1309
	F. 1198.5	1218.4	1162
	T. 1281.6	1279.3	1237

I confess to some surprise on finding that Dr. Boyd's results are so much in harmony with my own, for he manipulated the brains which passed through his hands in the Somerset County Asylum, as will be hereafter seen, in a manner which must have entailed a far greater loss of fluid and of weight than could possibly accrue through my method. Perhaps Dr. Boyd and I examined different proportions of lunatics of different classes, for it may be fairly argued that in the busy West Riding of Yorkshire, organic diseases of the brain with extreme wasting of the convolutions are of more frequent occurrence than in the purely agricultural county of Somerset, but this explanation of our agreement when we ought to differ is only feasible at first sight, for it is probable that the brains that are more liable to be invaded by organic disease are originally of better development and greater weight than those that are comparatively exempt from its attacks.

Before weighing the brains of the lunatics who died in the Somerset Asylum, Dr. Boyd had carried out a most laborious investigation of a similar kind in the Marylebone Parochial Infirmary, where from 1839 to 1847 he weighed the viscera—the brain amongst them—of 2086 persons who died in that institution. A large number of Dr. Boyd's observations were made on infants and young children, but he weighed the brains of 1424 persons above 20 years of age. As far as I know this

is the largest series of brain weighings on record, and it is therefore disappointing to have to conclude that it does not furnish altogether reliable data. And yet it is impossible to avoid suspecting some flaw in these tables when we find them representing the brains of sane paupers—for the majority of the infirmary inmates were presumably of sound mind—as being, in several of the decades included in our consideration, actually lighter than the brains of pauper lunatics who have perished under diseases which of all others compromise the nutrition and solidity of the brain. No doubt the social failures who take refuge in a workhouse are light of brain as well as of pocket. Either as the cause or consequence of their misfortunes, many of them are of defective cerebral development, but it is difficult to conceive that so large a proportion of workhouse inmates should fall short of the insane standard of brain-weight. But Dr. Boyd's Marylebone tables have been repeatedly quoted as affording a standard of British brain-weights, and have thus probably become the parents of some miscalculations and of injustice to the inhabitants of these islands as regards their position on the scale of cerebral development.

A trustworthy standard of British brain-weights has yet to be provided, and is very urgently needed. It is not to be obtained from workhouses, prisons, nor lunatic asylums—invaluable although the information be that may be drawn from these sources,—nor yet is it to be obtained from general hospitals, for I am quite satisfied that the human brain fluctuates in weight, even in health, more than has been hitherto suspected, and that during many constitutional diseases it is really in a state of temporary atrophy. In fever the fixed albumen of the brain and nerves, as well as that of the muscles, breaks down into circulating albumen, to be in its turn transformed into urea and other nitrogenous excreta, and in looking at the brain in fatal cases of continued fevers, I have often been struck by the amount of cerebral shrinking and compensatory serous effusion that has become visible on opening the cranium. The brain in fatal fever cases has always powerfully reminded me of what is seen in fatal cases of acute dementia, a disease of which the symptoms are almost identical with those of that

mental aberration that is sometimes witnessed during the convalescence after fever. But not only in fevers but in other acute diseases with or without delirium, and in chronic diseases in which there has been emaciation and prolonged bodily and mental inactivity, there is, I feel sure, some slight emaciation of the gyri with increase of intra-cranial serosity, which would invalidate the accuracy of any standard of brain-weights founded on measurements taken in such cases. The most trustworthy information is only to be obtained in cases where death has occurred suddenly, owing to accident happening during robust health, and a long period may elapse before a sufficient number of observations made under such circumstances to justify any generalisations shall be collected.

The difference in weight between the male and female brain in Table I. amounts to 136·2 grammes for all ages. This is in close accord with the result obtained by Mr. Clapham, which is 125·6 grammes; with that of Dr. Boyd, which is stated to be between 4 and 5 ounces—that is from 113·4 to 141·7 grammes; with that of the late Dr. Thurnam, which is 157 grammes; and with that of the late Dr. Skae, which is 128 grammes. The amount of this difference establishes the view that the greater weight of the brain in man as compared with woman is not in relation merely to his greater bulk but is a fundamental sexual distinction, for while the excess of height in the male over the female is estimated by Dr. Thurnam at 8 per cent., the excess of brain-weight revealed by my table is 11·4 per cent. But the difference in brain-weight in the sexes, set forth in my own tables and in those of Mr. Clapham and Dr. Boyd, does not, I think, fully or fairly represent the difference which actually exists. It is to be recollected that these tables are founded on observations made on the brains of lunatics, and mostly of chronic lunatics, and that in persons of this class wasting diseases of the brain, in which its substance is degenerated and its bulk reduced, are much more prevalent in the male than in the female sex. We have, unfortunately, no information as to the weight of the brain in the two sexes in perfectly healthy persons, but when that information is obtained it will show, I am satisfied, a balance in favour of the male sex of more than 136·2 grammes.

In the meantime probability is given to this anticipation by the curious fact not before noted, that the difference in weight between the male and female brain in the observations already made in lunatics is least at these periods of life when wasting brain diseases which principally affect males are most common, and is greatest at the two extremes of life, when men and women meet on more equal terms as regards their cerebral pathology. It is between 30 and 50 years of age that general paralysis which destroys four men to one woman, and other fatal forms of organic brain disease, involving extreme atrophy and preferentially attacking males, almost exclusively occur, and it is in this section of life that the sexual difference in brain-weight is reduced to the lowest point. Before and after this period men and women are much more on a parity as regards cerebral disease, and before and after this period it is that the male brain assumes a much more commanding superiority over the female brain as regards weight. This is pretty clearly demonstrated in Table III.

TABLE III.

Showing the average excess in Weight of the Male as compared with the Female BRAIN in Lunatics at different Ages.

Ages.	Excess of Male Brain. Dr. Crichton-Browne's Cases.	Excess of Male Brain. Mr. Clapham's Cases.	Excess of Male Brain. Dr. Boyd's Cases.
Under 20	231.3	134.4	
20 to 30	169.9	108.0	102.6
30 " 40	111.2	99.3	80.8
40 " 50	127.1	133.1	97.2
50 " 60	120.3	148.1	127.5
60 " 70	154.5	124.9	145.1
70 and upwards.	176.5	145.8	141.1
All ages.	136.2	125.6	109.5

The supposition that the difference in the weight of the brain in the sexes is really greater than the computations hitherto formed, and founded principally on observations made on the insane indicate, is corroborated by an analysis of such information as we possess touching the weight of the brain in sane persons. In Dr. Boyd's Marylebone tables, which deal with the brains of paupers, of whom only 17 per cent. died of

diseases of the nervous system, and of whom certainly an immense majority were free from mental alienation, the sex difference is 235 grammes for all ages above 20. In the tables of Dr. Peacock, founded on observations on the brain-weights of patients who died in the Royal Infirmary of Edinburgh, and who were all free from brain disease, the sex difference for all ages above 20 is 153 grammes. All available evidence, therefore, points to the conclusion that the brain of the male exceeds that of the female in weight to a greater degree than has been heretofore currently reported, and that the relatively small size of the latter is not to be accounted for by deficiency in stature or weight, but depends, as Broca has argued, as much on her intellectual as on her physical inferiority.

Respecting changes in the weight of the whole brain in the two sexes, and at different periods of existence, as indicative of its gradual evolution and involution, Table I. affords no information of any value, nay it tends to mislead, for what Hughlings-Jackson appropriately calls dissolution has interfered more or less with the natural progress of events in all the brains that have contributed to its formation. The influence of dissolution, as a disturbing agency in the table, is more prominently exhibited in the male sex than in the female; for whereas in the latter the brain is represented as increasing in weight till between 30 and 40 years of age, after which it somewhat unsteadily declines, in the former it is represented as reaching its maximum weight between 20 and 30, and as actually working up again towards that maximum from 50 to 80, after twenty years of great depression in weight. These twenty years of course cover the period of maximum mortality from brain disease, and of maximum destruction of cerebral tissue by morbid processes. In the succeeding decades organic brain diseases become gradually less common and less destructive, but their influence is still visible in the table, obscuring that progressive loss of brain-weight which is indubitably incidental to the advance of years.

Without dwelling further upon the circumstances which vitiate lunatic hospital returns as a criterion of the weight of the brain in the several stages of life, or even in the three great divisions of it, to wit, adolescence, maturity, and old

age; and without entering upon criticisms which would be necessarily lengthy and intricate of the various published tables of brain-weights in their bearing upon this topic, I may merely state the general deductions, drawn from all sources of information, which are, that the brain in both sexes undergoes a progressive increase in weight in each decennial period up till middle life; that in men it attains its greatest dimensions and weight between 30 and 40 years of age, and in women between 20 and 30; and that after this, at first slowly and then more rapidly, it decreases in weight *pari passu* with the intelligence.

As regards the relative weight of the two hemispheres, it will be noticed that in both sexes and in all decades of life, from 20 to 80, the right is heavier than the left one. The only exceptions to this rule are that between 40 and 50 and 50 and 60 in the female sex, and in the latter case in the male sex also, the left hemisphere is slightly the heavier of the two, but my impression is that an induction from a larger number of facts than I have been able to command will correct this anomaly. The greatest difference in the weight of the two hemispheres in the male sex occurs under 20 and after 70 years of age; and in the females under 20, and from 20 to 30. The two are most nearly of a weight in both sexes between 50 and 60. The table seems to suggest that the wasting of the gyri which accompanies most forms of chronic insanity, proceeds in the first instance more rapidly in the right hemisphere, and so diminishes the distance separating it from the left one as regards weight, and that towards the close of life the pathological changes on the right side advance more slowly, while those on the left side somewhat quicken their pace, and so again make more evident the preponderance of the right hemisphere.

I have no doubt that the conclusions at which I have arrived as to the relative weight of the hemispheres in lunatics will be found substantially correct, and that in a large majority of insane persons the right hemisphere is the heavier of the two. I venture to say this, although my conclusions are directly at variance with the dogmatic statement of Dr. Brown-Séquard, that the left hemisphere is "much larger" than the right one, and

are irreconcilable with the conclusions of Dr. Boyd, who weighed the hemispheres in 528 lunatics dying in the Somerset County Asylum, and in nearly 200 paupers dying in the Marylebone Infirmary, and who found that almost invariably the weight of the left hemisphere exceeded that of the right by about the eighth of an ounce = 3.5 grammes. The excess in weight claimed for the right hemisphere in my table is about equal to that claimed for the left by Dr. Boyd, being 3.0 grammes at all ages: but I cannot allege that this excess existed almost invariably; on the contrary, in 114 cases the left hemisphere was heavier than the right one, while in 42 cases they were equal in weight. In 249 cases, however, the right hemisphere was heavier than the left one, and in these the redundancy was much more decided than in the other class of cases in which the left hemisphere outweighed its fellow.

I cannot pretend to explain the disagreement between Dr. Boyd's results and my own with reference to the relative weight of the hemispheres, but can only maintain that my own observations were made with scrupulous care, in the presence of and with the aid of highly skilled assistants. Dr. Boyd's method of procedure is thus described in a note appended to his paper in the 'Philosophical Transactions' for 1861: "The brain was next examined. The right and left cerebral hemispheres were each removed in slices to the tentorium; the tentorium being divided in each side, the cerebellum with pons and medulla was raised; the crura cerebri being divided close to the pons, each part was weighed, the pons and medulla together." I think most practical pathologists will agree with me that Dr. Boyd's method of slicing the hemispheres previous to weighing them, and while they still remained in the skull, was not as likely to give accurate results as that method of weighing the hemispheres while they were still intact which I adopted, and an outline of which has been already given.

I am fortified in my opposition to Dr. Boyd's conclusions by finding that Professor Wagner and the late Dr. Thurnam have both disputed them. From the weighing of the hemispheres of eighteen distinct brains, the former ascertained that the right hemisphere was heavier in ten and the left in six cases, while in the remaining two they were of the same weight.

Dr. Thurnam states that his observations did not confirm Dr. Boyd's, adding that "fresh careful observations are certainly needed before we can admit the general preponderance of the left hemisphere over the right." Without entering into details, and disclaiming any pretensions to minute accuracy, he gives an abstract of his recorded results, which shows that in his cases the right hemispheres weighed in the male sex at all ages 570, and the left 569 grammes; while in the female sex at all ages the right hemispheres weighed 511, and the left 510 grammes. Thus, according to Dr. Thurnam, the average weight of the right hemisphere is 1 gramme greater than that of the left in both sexes.

(To be continued.)

OBSERVATIONS ON NEURITIS AND PERI-NEURITIS OF SOME OF THE CRANIAL NERVES.

BY JULIUS ALTHAUS, M.D., M.R.C.P., LOND.

Senior Physician to the Hospital for Epilepsy and Paralysis, Regent's Park.

INFLAMMATION of the nerves is by some pathologists considered to be an extremely rare, and by others a more common affection. Dr. Weir Mitchell, an American surgeon to whom we owe an able monograph on injuries of nerves and their consequences, of which he saw numerous examples during the American civil war, considers acute idiopathic neuritis an uncommonly rare disease; while Benedict, Remak and others appear to have enjoyed almost daily opportunities of meeting with such cases. My own experience leads me to believe that instances of this description are certainly more common than is generally supposed, and that although the evidence of post-mortem examinations is as yet not large, nevertheless the clinical symptoms are in many cases sufficiently striking to warrant the diagnosis of neuritis or peri-neuritis. One special affection of this class has recently been very closely investigated—I allude to optic neuritis, in which the changes going on in the nerve may be closely followed by the aid of the ophthalmoscope; and the observations made on this disease by Von Graefe in Germany, and Drs. Jackson, Clifford Allbutt, and others in this country, have thrown considerable light on its pathological relations. It is my purpose in the present communication to draw attention to the occurrence of inflammation in some other cranial nerves, where it has not yet received the amount of consideration which the interest of the subject seems to warrant. Indeed, I have not been able to discover in medical literature any records of acute olfactory

and auditory neuritis, of which I will relate instances which have fallen under my observation; while with regard to inflammation of another nerve—the portio dura of the seventh pair—indeed a considerable amount of information has been obtained, yet many of the clinical features of the affection are not as yet well known, although they are of great importance in their relation to diagnosis, prognosis and treatment.

Inflammation may attack the entire structure of the nerve or only its investing membrane, the peri-neurium, which consists of connective tissue with small blood-vessels and nerves. According to this we speak of neuritis or peri-neuritis. The fundamental difference between the two diseases appears to me to be, that in neuritis the central core or cylinder axis undergoes the same degeneration as all the other portions of the nerve, while in peri-neuritis this important part escapes destruction.

In acute neuritis there is at first hyperæmia, more particularly in the smallest veins and capillary vessels, and less in the arterioles. The nerve appears to the naked eye uniformly congested, or dilated blood-vessels may be distinguished, more particularly in certain portions of the same, as, for instance, where it traverses an osseous canal, the walls of which are unyielding and therefore add to the intensity of the inflammatory symptoms. The nerve is swollen, moist, and turbid; and the smaller bundles of nerve-fibres are surrounded by a serous or fibrinous effusion, which has a grey or reddish jelly-like appearance, and often contains hæmorrhagic spots of variable size. If the nerve be examined microscopically, it is found that crowds of white corpuscles have migrated into the sheaths of Schwann and the septa of connective tissue, which divide the nerve into its smaller funiculi. The myeline or medullary substance of Schwann appears divided into segments; softening and suppuration set in, and the structural elements of the nerve, including the cylinder axis, become disorganised, and disappear. Ultimately there is cicatricial shrinking, proliferation of connective tissue, and formation of oil-globules and amyloid bodies: that is sclerosis and atrophy. The nerve is then changed into a cord of connective tissue, which is intimately connected with the neighbouring parts.

The inflammatory stage of acute neuritis lasts, according to my observations, from four to six weeks.

Neuritis may also be chronic, when there is less tendency to suppuration and softening, and more to primary sclerosis. Proliferation of the connective tissue is then the most prominent symptom, and Virchow has therefore called this form *interstitial proliferating neuritis*. The nerve appears thickened and hardened; it has lost its brilliancy and is more cloudy, and there is only moderate hyperæmia. Wasting of the nerve-structures is then much slower, and caused more by pressure than by active inflammation. Again, there are cases where not only the connective tissue, but also the nerve-structure becomes hypertrophied. This process is designated as *hyperplastic parenchymatous neuritis*, and may lead to the formation of neuroma. Where the inflammation is not uniform, but more disseminated, affecting some parts and sparing others, the nerve assumes a spindle-like or nodulated appearance, and we then speak of *neuritis nodosa*. Sometimes there is a tendency for the inflammation to spread to a considerable distance beyond the point originally affected, both upwards and downwards; this is called *ascending and descending neuritis*. The former of these may ultimately reach a nervous centre, and then give rise to symptoms of much greater gravity than are ever caused by peripheral neuritis.

Where the inflammation is not severe, it does not proceed to destruction of the contents of the nerve-tubes, or at least only to partial destruction. Regeneration of destroyed nerve-fibres may then take place, and is generally protracted over three months, or even longer. This regeneration seems more easily effected in nerves which have only the function of common sensation and motion, and less easily in those which belong to the special senses. Thus I have seen it to occur where the fifth nerve was affected, even in a severe degree; while when the olfactory, auditory, or optic nerves have suffered in this manner, there is very much less chance of regeneration. Peri-neuritis is of course, other things being equal, much less grave than neuritis, as the inflammation is, in this disease, more confined to the sheaths of the nerves, and does not implicate the cylinder axis.

The causes of neuritis may be local or general. All the various kinds of injury may give rise to it; cold is likewise a fruitful source. Certain systemic affections, such as diphtheria, small-pox, typhoid fever, pneumonia, rheumatic fever, lead to it. Syphilis causes neuritis, not so much primarily as by spreading of inflammation from neighbouring structures, more particularly the peri-osteum and bones, the membranes of the brain and spinal cord, &c. In the same way non-syphilitic inflammation or irritation of contiguous parts may give rise to neuritis. In lepra anæsthetica there are evidences of chronic peri-neuritis; and progressive locomotor ataxy is very frequently ushered in by neuritis of one or several of the cranial nerves.

1. *Olfactory neuritis*.—The first case I wish to relate is one of acute idiopathic neuritis of the olfactory nerves, which occurred in a patient who is now under my care at the hospital, suffering from progressive locomotor ataxy. C. S., a banker's clerk, aged 48, married, and father of two children, had been in tolerably good health until about eight years ago, when, apparently without any particular cause, he suddenly began to feel numbness in his feet, and lost the proper perception of the hardness of the ground. It seemed to him as if he was treading on india-rubber balls, or bales of cotton. About the same time he was startled by perceiving a strong smell of phosphorus, which overpowered all other accidental smells, and never left him at all for about six weeks. At the end of that period he noticed that he had entirely lost the sense of smell for odorous substances of any description. The smell of phosphorus had then given way to a persistent and not unpleasant kind of scent-sensation, which he compared to that of civet, very much softened down. This sensation continued for several years, but is now likewise gone; and there is at present a total absence of any olfactory sensibility. I tested the patient with assafoetida, ether, valerian, camphor, millefleurs, opoponax, and a variety of other strongly smelling substances, either pleasant or disagreeable, none of which, however, caused the slightest effect upon his nose. He did perceive ammonia, which caused lachrymation and a choking sensation, just as in healthy persons, and also the vapour of strong acetic

acid, and snuff, which caused sneezing. All these last-named substances, however, act on the nerves of common sensation, *i.e.* the nasal twigs of the ophthalmic branch of the fifth nerve, and of the spheno-palatine ganglion.

The perception of flavours in eating and drinking was likewise almost entirely gone. It is a well-known fact that the gustatory nerve only responds to four different kinds of sapid substances, *viz.* the saline, the acid, the bitter and the sweet; and that flavours are recognised by the olfactory, not by the gustatory nerve. In accordance with this I found that, when the patient's eyes were bandaged so that he could not see what he was eating or drinking, he was unable to distinguish between stewed onions, apples, and turnips; although he could tell roast beef from roast mutton. He did not perceive the flavour of port wine or claret, but felt the former hotter than the latter, saying it was gin or brandy, while claret appeared to him like water. These sensations were evidently owing to impressions made on the lingual and palatine branches of the fifth nerve, and partook of common sensation rather than of especial sense. It is a singular fact that, until experimented upon in this manner, the patient was not aware that he had lost the perception of flavours, but thought that he tasted everything quite as well as previously to having lost his smell—vision and memory evidently supplying in this instance the lost sense.

It is not necessary for my present purpose to enter into further details of this case. Suffice it to say that all the usual symptoms of ataxy, with regard to motion, sensation, and reflex action in the upper and lower extremities, as well as the condition of the bladder, rectum, and sexual organs, were present, and that the patient offers one of the most perfect types of sclerosis of the posterior columns of the spinal cord that could well be imagined.

Remarks.—In considering the pathology of this singular and instructive case, several questions force themselves on our notice. 1st. Was the loss of smell owing to an affection of the nerve, or of the accessory mechanism of smell? •Anosmia, or loss of smell, may arise from either of the two. Thus we find it coming on through acute or chronic inflammation and

thickening of the mucous membrane of the nose, more particularly from ozæna of syphilitic or strumous origin; from polypus; from adhesion of the soft palate to the posterior wall of the pharynx, which prevents the air from passing through the olfactory channel of the nose, &c. Again, we find smell impaired in facial paralysis from lesion of the portio dura, owing to loss of power in the compressor and dilator naris muscles. Both these muscles are of importance to olfaction, each serving for a particular mode of smelling at a substance. When we smell by taking a long forcible inspiration through the nose, while keeping the mouth closed, the nostrils become dilated in order to admit as much of the air charged with odoriferous substances as possible. In facial palsy this active dilatation of the nostril is impossible on the side of the lesion, so that smell will be impaired. In sniffing, however, which is really more effectual than one long inspiration, the compressor naris muscle comes into play. The air is then drawn in by a rapid succession of short and shallow efforts, during which the nostrils contract; the object of this being to close the lower respiratory channel, and to allow the air to pass through the upper olfactory channel. Lateral compression of the nose, however, is impossible where the compressor naris is paralysed, so that the patient affected with facial palsy cannot sniff. A final reason why smell suffers in that disease is that the tensor tarsi, or Horner's muscle, is paralysed. This small muscle, which is really a portion of the orbicularis oculi, draws the openings of the lachrymal ducts backwards, so that they may absorb the tears; and where it is put out of action, the tears are apt to run down the cheek instead of entering the nasal cavity, thus rendering the latter unnaturally dry, and therefore not well suited for the perception of smells. In all such cases smell may be impaired or lost, and yet the olfactory nerves and their centre in the brain be quite healthy; but in the present case the whole accessory mechanism of smell was in perfect order. The conclusion is therefore inevitable that the nervous arrangement had suffered at some point of its course between the nose and the brain.

The second question, therefore, which we have to consider is whether the nerve affection which led to the loss of smell

in the present instance was a peripheral or a central one? Was it owing to some disease of the first pair of cranial nerves, or of the olfactory centre in the brain?

The centre of smell in the brain is believed to be situated near the island of Reil and the fissure of Sylvius, and in close proximity to the third left frontal, or Broca's convolution, which is known to be the seat of intelligent language. Thus we find anosmia occasionally associated with aphasia and right hemiplegia, from softening of, or hæmorrhage into, these structures. In such cases, however, the loss of smell is unilateral, and confined to the side of the lesion, which in aphasia is always the left side of the brain. We have therefore right hemiplegia and left anosmia. This apparent discrepancy is satisfactorily accounted for by the circumstance that there is no decussation of the olfactory paths in the anterior commissure which joins the two temporo-sphenoidal lobes of the brain, and smell, therefore, is appreciated on the same side on which it is perceived. Experimental physiology has gone a step further in localising the seat of the centre of smell even more exactly. Dr. Ferrier¹ finds this centre to be situated in the tip of the temporo-sphenoidal lobe, or the subiculum cornu ammonis, which appears likewise to contain the centre for the perception of taste. Faradisation of this part in monkeys, cats, dogs, and rabbits, is followed by a peculiar torsion of the lips, and partial closure of the nostril on the same side, *i.e.* a sniff. Similar signs are produced by the direct application to the nostrils of powerful or disagreeable odours; and they are unquestionably the outward expressions of the excitation of subjective olfactory sensations of an intense character. Again, while stimulation of the subiculum causes olfactory perceptions, destruction of this part appears to cause loss of smell. Thus, for instance, it was destroyed in the left side of the brain, and a piece of apple was then offered to the animal, who took it, smelt it, and began to eat. The right nostril was then securely plugged with cotton wool, and a piece of apple was once more offered. The animal again took it, but hesitated before eating, raised it repeatedly to the nostril and endeavoured to smell it, but apparently

¹ 'The Functions of the Brain' (London, 1876), p. 188.

without success. An additional fact tending to show that the subiculum is the centre of smell is that its structure is particularly developed in animals endowed with a very keen sense of smell, such as the dog, cat, and rabbit; and in them the anatomical connection of the olfactory tract with the subiculum is evident to the naked eye. In the monkey and man, where smell is not so keen, this connection is not so patent, yet thoroughly established by microscopical investigations.

Was therefore disease of the subiculum the cause of the anosmia in the present instance? To this I feel compelled to give a negative reply. We have seen that there is no decussation of olfactory paths in the anterior commissure, and that in central softening or hæmorrhage the loss of smell is confined to one side. In the present case, however, the affection was bilateral; and, moreover, the sense of taste was perfectly normal. Surely if there had been a lesion extensive enough to destroy both subicula, other symptoms, and more particularly loss of taste, would have been present. In their absence it seems to me permitted to assume that the lesion was a peripheral one, and occurred most probably where the olfactory ganglia lie closely together at the base of the brain, on the ceribriform plate of the ethmoid bone.

The third point which I wish to discuss in connection with this case is the pathological nature of the affection. In considering this we cannot derive any assistance from post-mortem records of such or similar cases. It is true that sclerosis and atrophy of cranial nerves have been discovered in cases of ataxy which have proved fatal at an advanced stage of the complaint; but this does not give us any clue to the question whether the original lesion was inflammatory or one of simple disintegration, since both lead to sclerosis. Nor are the indications given by the ophthalmoscope in the amblyopia and amaurosis of ataxy altogether decisive, as it is not yet decided whether the lesion of the optic nerve in these cases is one of simple atrophy, or of neuritis which has led to atrophy. We are therefore obliged to look to the clinical symptoms of the case as our guide in this matter. There was at first a stage of sensory hyperæsthesia which, after having

lasted for six weeks, merged into complete anæsthesia of both olfactory nerves. This corresponds closely to what I have observed in neuritis of the fifth nerve, where there is likewise a stage of hyperæsthesia, as evidenced by severe pain in the parts supplied by that nerve, and lasting for five or six weeks, after which complete anæsthesia and motor paralysis of the muscles supplied by the small root of the nerve set in.

What is the meaning of the singular symptom of the patient perceiving the smell of phosphorus during the whole first period of the disease? I believe I am in a position to affirm that the olfactory nerve responds to stimulation other than by special odoriferous substances, by perception of the smell of phosphorus. It is well known that the constant voltaic current has a peculiar action on the nerves of special sense, which answer to its passage by certain well-marked sensations. Thus, galvanisation of the optic nerve causes flashes of light, of the gustatory nerve a coppery taste in the mouth, of the auditory nerve a singing or hissing noise in the ear. It is easy to demonstrate these facts, because the nerves I have just mentioned are very sensitive to the influence of the voltaic current, and therefore respond to a slight power; while the olfactory will only give an answer when a very high power is used. A powerful voltaic current, however, when applied to the nose or any other part of the face, causes such disagreeable sensations of pain, giddiness, sickness, fainting, together with dazzling flashes of light and loud noises in the head, that experimenters in general have been unwilling to bear the inconvenience of the procedure, or unable to analyse all the various sensations perceived at the time. The fact, therefore, that the olfactory nerve does respond to the voltaic current by the perception of a phosphorous smell was not established until some years ago, when I demonstrated it in a patient who suffered from bilateral anæsthesia of the fifth pair of cerebral nerves. In that case a strong voltaic current could be borne without inconvenience, because the patient was insensible to a moderate power. The patient was in perfect health, except as far as the affection of the fifth nerve was concerned. His smell was keen; and when the current was directed to the mucous membrane of the nose, which was insensible to ordinary stimulation, the patient inva-

riably, and without being questioned about it, said, "I smell phosphorus;" just as he mentioned that he saw flashes of light when the current was directed to the eyes. It is fair to assume that irritation of the olfactory nerve by hyperæmia and inflammation will cause a smell of phosphorus; such as I have shown to follow voltaic irritation of the nerve, and just as in retinitis flashes of light are perceived by the patient. All these circumstances taken together appear to me to warrant the conclusion at which I have arrived, that the case just related was one of *acute olfactory neuritis*, ushered in by hyperæsthesia, and marked in its later stage by anæsthesia of this special sense.

[(*To be continued.*)]

Critical Digests and Notices of Books.

Luciani and Tamburini on the Functions of the Brain. Ricerche sperimentali sui centri psico-motori corticali dei professori Luigi Luciani e Augusto Tamburini. 1878.

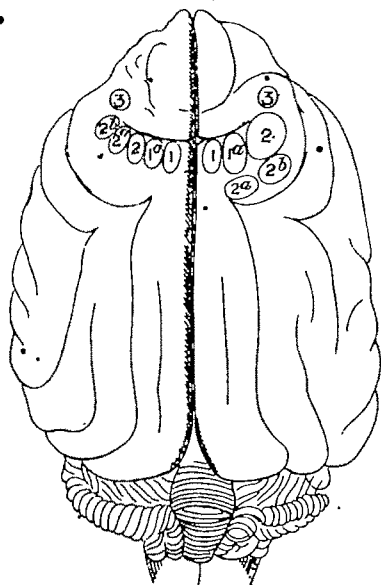
IN this memoir Professors Luciani and Tamburini confine themselves to a consideration of the motor points of the cerebral cortex, reserving for a future paper the more difficult consideration of the sensory centres of the cortex, or the psychic centres. Their experiments were made by means of an induced current for the most part, and always after the use of some anæsthetic, as chloroform, or ether, or the injection of laudanum. A medium amount of narcosis was found by them, as by Dr. Ferrier and other experimenters, to be the most suitable. If it was too deep, the effects were not obtained: if too slight, epileptiform convulsions were apt to ensue. Their twenty-six carefully conducted experiments bring out some new points, not entirely in agreement with the views of other authors, while some of them are more or less subversive of received opinions. The idea that the cerebral cortex had in any way to do with motion (except, it may be supposed, as the organ of volition) may have been hinted at by others, but received no general assent till the publication of the results obtained by Fritsch and Hitzig in 1870. It was soon found, however, as is always the case when the world wakes up to new truth, that the labours of the best workers supported the new views; and, in particular, the work of Dr. Hughlings-Jackson, to whom Dr. Ferrier's book was dedicated in 1876, has come more prominently into notice. Not, however, yet so much as its merits justify, not so fully as we confidently believe the future generation will study those records of care-

ful clinical work. In this country Dr. Ferrier's work gave the subject its first great publicity, and that still remains the standard book on this department of the physiology of the nervous system. I do not here propose to weary the reader with a long or elaborate account of what he may find much better set forth in the work in question; but, assuming that he is acquainted with the chief points therein stated, and premising that its main conclusions are not subverted or likely to be so by later work, will go on to point out one or two particulars in which Messrs. Luciani and Tamburini differ from Dr. Ferrier and other authorities.

1. We may view it as a matter of detail, and yet it is of some consequence, to find that our later authors differentiate more finely than Dr. Ferrier the movements dependent on irritation of points in the cerebral cortex. Thus we find in dogs that the cortical centres for the movements of the limbs, which lie just behind the cruciate sulcus (homologous with the fissure of Rolando in the higher vertebrates) may be shown to determine different movements, according to the part of the centres irritated. For instance, the centre for the opposite posterior extremity lies in dogs more internal than that for the opposite anterior limb. (This result agrees fairly with Dr. Ferrier's.) But Messrs. Luciani and Tamburini show (see Experiments V. and VI.) that irritation of the inner portion of each of these centres causes *extension and retropulsion* of the fore or hind limb, as the case may be; while irritation of the outer portion of each centre induces *flexion and advance* of the same. This finer differentiation of function is of such a kind as might have been expected as a consequence of minuter experimentation. There appears also to be an intermediate zone, by irritation of which movements of both sets of limbs may be obtained. As in other instances, however, a deeper amount of narcosis causes the cessation of the movements.

2. A point which seems to be of considerable importance is the following: Luciani and Tamburini assert that electrification of the cerebral cortex both in dogs and monkeys shows by no means slight differences of locality and specification, both as between one animal and another of the same species, and also as between the two hemispheres of the same animal. For an

interesting and instructive instance of the latter, see Experiment XX. In this experiment (see diagram) perfectly similar portions of the skull were removed in a dog, and similar applications made of the induced current to similar parts of the



exposed brain. These are the results. On the right side, irritation of 1 was followed by abduction and flexion of the left posterior extremity; of 1A (external to 1), by elevation and advance of the same. External to the latter there is a more extended area, 2, excitation of which produces abduction and elevation of the left anterior extremity. Behind 1A there is a small centre, 2A, for flexion of the forearm on the arm, and contemporaneous movement of the shoulder. Behind 2 there is a similar centre for the retraction and adduction of the left anterior extremity, 2b. The centre for the movements of the head and neck is found to be in the usual position, 3.

In the sigmoid gyrus on the left side the movements obtained were quite unsymmetrical. Proceeding from within outwards we come to, 1, a centre for abduction and retropulsion of the right posterior extremity; a second, 1a, for extension, elevation, and advance of the same, a centre, 2, for the simple

abduction of the right anterior extremity; another, 2a, for the abduction, advance, and elevation of the same; and yet another, 2b, for the simple elevation of the same limb. The centre for the movements of the head and neck were symmetrical with the other side, 3.

So important a consideration as the want of symmetry between the sides of the brain in a given animal cannot fail to have grave consequences for future investigators. Unless the law of the asymmetry can be laid down, it appears that conclusions drawn from the pathological appearances, say of one side of the brain, will have to be received with extreme caution; while as regards homology even more serious doubts naturally suggest themselves.

Messrs. Luciani and Tamburini object, with seeming justice, to Dr. Ferrier's method of experimentation, which consists in exposing a large part of the right hemisphere in one animal, and a great part of the left in another. This method is faulty, because, besides the asymmetry just referred to, it is impossible to have exactly similar conditions present, no account being taken of the amount of hæmorrhage, of the amount of injury suffered, of the exhaustion of the two animals compared, of the narcosis, and of the precise amount of the electrification.

It may be mentioned here that the Commission appointed by the Society of Neurology and Electrology of New York give a qualified opinion in favour of the symmetry of the two sides, though they point out that "the two sides of the brain in the dog are not exactly symmetrical, either as regards the sulci or the convolutions." A reference to our diagram will, however, suffice to show that far more functional asymmetry exists than the anatomical differences between the two sides would lead us to expect.

3. Messrs. Luciani and Tamburini's experiments show that the excitable areas for the limbs and face in monkeys are not limited to the ascending frontal convolution, as maintained by Hitzig, but that Ferrier is right in maintaining that they extend also to the ascending parietal and angular gyri, &c.

4. They are, however, totally opposed to Ferrier when he asserts that the paralysis which follows ablation of the cortex

in monkeys is permanent. They declare that it is temporary, and offer as proof the simple fact that a monkey from which they removed some of the cortical centres on the left side on the 24th of February, 1878, was alive and well on the 20th of June, the only motor change then existing being that it used its left hand by preference, whereas it formerly was in the habit of using the right. Ferrier no doubt carefully refrains from going beyond what his experiments warrant, and says no more than this, that in the monkey which in his hands lived longest (nine days) after ablation of the cortical motor centres, there was no appearance of reparation. But the whole force of his reasoning from the similarity of construction of the monkey's brain to that of man is founded on the assumption that lesions of both are followed by permanent paralytic effects; and it is well that we have now more light on the point.

5. As to the production of Artificial Epilepsy. The reader is probably aware that Albertoni has advanced the view that "there is a definite and determinate convolution of the cerebrum, whose slightest electrical or even mechanical excitation is followed by the development of the epileptic paroxysm, so that we may name this the epileptiginous zone of the brain—a zone which contains many of the excitable centres of the brain, such as were discovered by Hitzig and Ferrier. Other points determine epilepsy, but with a stronger and more continued current, probably propagated. And in such cases the convulsions are slighter," &c.

This view, though advanced later than the investigations both of Hughlings-Jackson and Ferrier, and after study of the views of these authors, is not, in the opinion of Messrs. Luciani and Tamburini, at all made out by Albertoni, nor is it in consonance with facts. Hughlings-Jackson, after careful study of convulsions confined to certain muscles, or to the muscles of the half of the body, and after comparison of these with corresponding necroscopic lesions, was the first to conclude that some forms of epilepsy, if not all, depended on lesion of the cortical centres, capable of determining periodical tensions and discharges, about the region of the corpora striata. The experimental researches of Fritsch and Hitzig

to some extent verified this opinion. Ferrier's conclusions, with which Luciani and Tamburini agree, are that "while moderate excitement of a centre produces only contraction of the muscles in co-ordination with that centre, a stronger excitation produces a kind of epileptiform condition of the same muscles. If the excitement was prolonged upon a motor centre alone, the corresponding muscles were seized with clonic spasm, which in some cases remained confined to them. In others, on the other hand," he says, "I saw the convulsions attack other groups of muscles, more particularly those whose centres had been already stimulated."

It is difficult to understand how Albertoni can have come to his conclusion after the wider views of his predecessors in this field, unless we suppose that he assumed that epilepsy was something apart from the phenomena which go to make up the condition. Varied as are its manifestations, affecting in different cases different muscles and sets of muscles, probably the best definition of the epileptic state would be that it is "a potential excitability, tending to pass into actual excitement, of nervous centres governing certain groups of muscles." We should probably understand the condition better if we dropped the name. On this view, cramp, originating centrally, might be viewed as included in the definition,¹ the distinction between the grade or rank of the centres affected being looked on as accidental.

The inquiry of Albertoni might, however, be viewed more widely (in which case its importance would be enhanced) as an attempt to study comparatively the degree of excitability of the different cortical motor centres in different animals. To this question Luciani and Tamburini have given some attention, and their tentative conclusion is that "the different excitable areas appear to be diversely extended, probably because endowed with a different degree of excitability": this might have been inferred from several considerations, and chiefly from the fact that to produce a complete epileptic

¹ Is there any real difference in kind between tonic and clonic contraction of muscles? Is not tonic contraction a form of clonic in which the intervals are so short as to be unnoticed? • •

seizure by acting on the same excitable areas, there is required a varying degree of the electric current.

6. Luciani and Tamburini have determined by experiment that it is absolutely impossible that movements produced by electrification of the cerebral cortex can be due to diffusion of the current to the *dura mater*. This they prove by snipping and electrifying the cut edge of the *dura mater*, and also by electrifying it *in situ* after the insertion of a layer of thin glass between it and the surface of the cortex. In both cases the effects are negative. The movements, therefore, which occur when the *dura mater* is electrified in position must be due to transmission of the current to the brain substance itself.

7. In opposition to Schiff, it is asserted by Luciani and Tamburini that the phenomena of impaired motility consequent on ablation of the excitable parts are in their nature absolutely paralytic and not ataxic.

8. The paralytic phenomena just named are transitory, but are of the longer duration, that is, compensation is effected the more slowly, the higher we ascend in the animal scale. We have already seen that this transitory character belongs even to the phenomena as they occur in the monkey. It may be here mentioned that Luciani and Tamburini in one experiment removed in a monkey certain portions of the cortex, leaving, however, intact Ferrier's area 5 (governing "extension forwards of the opposite arm and hand as in touching an object"). To their surprise the movement in question was paralysed, instead of being preserved as they expected. From this they conclude that in different individuals, particularly if of different races or species, the position and powers of centres may vary very much.

9. How is recovery from the paralytic phenomena to be explained? On this point almost as many different opinions have been held as there have been inquirers in the field. Flourens, the first investigator, experimenting on animals such as pigeons, found that any effects of ablation of the cerebrum speedily disappeared, and was hence led to formulate his law of compensation: "The entire mass of the brain being functionally homogeneous, the functions of parts destroyed may

be perfectly replaced by remaining parts, even if these are not extensive." The discovery of special cortical motor centres led Hitzig to an opinion entirely different. He thought that recovery after ablation must mean that the whole of the centres governing the temporarily lost movements could not have been removed, and that the remaining portions multiplied their powers till they fulfilled the same offices as the centres when intact. Soltmann thinks that the corresponding part of the opposite hemisphere takes on the lost function, or perhaps the cerebellum obtains new powers. Carville and Duret found (1) that if, after recovery from the effects of removal of the centres for the limbs on one side, the homologous centres be removed on the other, this causes not paralysis of both sides, but only of the limbs opposite to the side last operated on. (2) Even when the centres on both sides are removed, recovery still takes place. Therefore they conclude (1) that Soltmann's view is untenable, and (2) that the functions of destroyed parts of the cerebrum might be replaced by neighbouring parts—a view closely related to that of Flourens. Goltz's view was apparently like Soltmann's second suggestion, that the cerebellum governs the movements recovered, but was really very different from it, since he held that the cerebellum really governed movements, such as walking, running, &c.; but that the operation of removing the cerebrum (which he carried out by means of the water-jet, and more completely than had yet been done) for the time interfered with the proper action of the cerebellum. The action of the cerebrum he looked on as inhibitory. Ferrier's view is thus expressed: "The various classes of animals start from birth with different degrees of primary organisation of the powers of locomotion, in the mesencephalic centres." In his opinion the initial movements dependent on the will tend to become localised automatically in the corpus striatum, and thus he thinks that a dog deprived of its cortical centres might perform perfectly well all the automatic locomotor movements which are found located in the basal ganglia; but could not perform movements not habitual to it, and which the animal might have learned by education and the exercise of the will.

Now Flourens' view is quite incompatible with further

experiments, and could not have been maintained, had he experimented on higher animals. Hitzig's view is demonstrably unsound, since the whole centre governing certain movements has been seen to be removed in cases where recovery took place. The effects of bilateral mutilations, contemporary and successive, both in dogs and monkeys, are absolutely irreconcilable with the doctrine of Soltmann (see particularly Luciani and Tamburini's expt. xxvi.). The effects of repeated unilateral mutilations are irreconcilable with the doctrine of Carville and Duret. Finally, the comparative effects of removal of areas, both excitable and non-excitable, quite exclude the doctrine of Goltz.

On the doctrines of Ferrier, Messrs. Luciani and Tamburini thus express themselves: "An observation of the simplest character suffices to discover the vulnerable point of Ferrier's doctrine. He does not in the least explain the recovery of dogs deprived of their cortical centres. Strongly impressed with the results he has obtained in monkeys (which we have shown to be somewhat faulty), he formulates a doctrine which, if applicable to these animals up to a certain point, is wholly inapplicable to dogs and other mammalia, without denying the existence of true motor cortical centres in the latter, without considering—as Goltz does—the immediate effects consequent on their removal, as phenomena of moderation or of temporary suspension of the functional activity of the ganglia of the base. If, with Ferrier, we held that a dog deprived of its cortical motor centres has definitely lost all that was voluntary in its movements, and preserved only what was automatic and habitual, it would be necessary to conclude (since in a few days it differs in no respect from a dog intact, as regards motility) that this animal in its ordinary normal condition, or before being trained, is in the strictest sense an automaton; that there is nothing whatever voluntary in all its movements; and that all its acts and manifestations depend on an organic substratum, fixed and immanent in the opto-striated system.

"True it is that Ferrier, in perceiving these strange corollaries from his doctrine, attempts to explain the apparent voluntary character of the movements of the dog deprived of

its cortical centres. Preserving the sensory centres (this is something like what he would say), it is an animal conscious, sentient, capable of ideation and of emotion, and thence also of spontaneous acts, that is to say, not dependent on present impressions excited from without, but on past impressions, revived or imaginative (*ideals*), which have the power, like the former, of setting in action the automatic apparatus of movement. But Ferrier does not perceive that, in admitting so much, he runs upon more dangerous rocks, and that unwittingly he deals a mortal blow to the general doctrine of the cortical centres, as he conceives it, and as before him it was conceived by Hitzig; in which doctrine it is contended that the said centres are the only way by which the diverse psychic activities manifest themselves by being transformed into movement. As Hitzig expresses it, 'It is the circumscribed points of the cerebral cortex which are assigned to the diverse psychic functions, for their ingress into matter, or for their egress from the same.'

"If it be admitted that the diverse psychic functions (ideas, emotions) may by other ways than those of the cortical motor centres excite the corpora striata, and by means of the excitement of these reach their complete outward manifestation, who does not see that in such a case the different areas of the cerebral cortex which Ferrier, in the words of Carville and Duret, considers as centres of voluntary motion, would be reduced in dogs to a mere superfluity, or rather to the expression of a simple capability of the further reflecting of the ganglia of the base?"

The view of our authors is expressed thus:—

"Doctrine of the cortical psycho-motor centres.

"The opinions of former writers having thus been shown to be untenable, the following conclusions are offered.

"So far, two general facts may be formulated in the following manner:—

"(a) The paralytic effects consequent on destruction of the cortical motor centres are of a different degree of intensity in different mammalia, of small account in inferior mammals, clear and distinct in animals more elevated in the zoological scale, complete and more or less absolute in man.

"(b) The effects pass off and are compensated for, the more

quickly and completely the less is their intensity, and the lower in the animal scale is the individual in which they are produced.

"The proximate and immediate explanation of these general facts may be given, it seems to us, in a manner lucid, clear, and unequivocal. When, after removal or destruction of certain areas of the cerebral cortex, which reacted to electrification by determinate movements of certain groups of muscles, we see paralysis of such movements immediately follow, we infer that the portions removed are the motor centres for those muscles. If the paralysis consequent on such operation appear complete and absolute, we should say that the part destroyed comprehends all the motor centres of the paralysed muscles. When, on the other hand, the paralysis is incomplete and relative, that is an indication that the centres destroyed are not the only and exclusive motor centres of the corresponding muscles; or, more explicitly, that besides the cortical centres, the said muscles have other motor centres in some other part of the cerebrum. Admitting, till the contrary is demonstrated, that this other part is represented by the basal ganglia, and particularly—in accordance with the views of the great body of physiologists—by the corpora striata, we come at once to this conclusion: There exist in many mammals two orders of motor centres—cortical, and basilar or striated motor centres.

"Following out this obvious course of reasoning, we can now pass to more minute determinations. When, after the separation of the cortical motor centres, we observe only slight paralytic effects ensue, as happens in dogs, in cats, and specially in rabbits, we may conclude that in these animals the basilar motor centres predominate in a more or less marked manner over the cortical motor centres. When, on the other hand, destruction of these centres is followed by paralysis, nearly or quite complete and definitive, as in the monkey and man, we are led to the conclusion that in these animals the cortical motor centres either predominate over the basilar, or represent the only and exclusive motor centres of the brain.

"Is now the nature of the movements excited by the two orders of centres, or is it not, essentially different? In other words, can we establish between the cortical and basilar centres

a clear difference of signification or physiological value, taken from the specific characters of their respective function?

"It cannot be doubted, after the experiments on monkeys, both of excitation and destruction of the centres, that the movements excited by the cortical centres have the characters of purely voluntary movements. We are therefore in complete accord with those who consider the cortical centres as centres of voluntary motion. We express this fact by calling the cortical centres not simply motor, but psycho-motor, that is, motor centres which are in direct relation with psychic centres, and by means of which the *psyche*, or the conscious activity of the cerebrum, expresses with different movements certain forms of excitements, or modifications which take place in it and have their origin in it.

"Do then the movements excited by the basilar ganglia possess characters purely mechanical or automatic, or have these centres perhaps the power, virtually or efficiently, to express and respond with suitable movements to the impulses of the will? All the considerations advanced in the preceding chapter regarding Ferrier's doctrine concerning the destruction of the cortical motor centres in dogs, lead us of necessity to conclude that the basilar ganglia also, and particularly the corpora striata, may possess the physiological value of centres of voluntary movement, or of centres which may be put directly into action by psycho-motor processes. The results of experiment on the monkey lead to the same conclusion, since after destruction of the cortical psycho-motor centres we have seen almost complete, but not quite, destruction of voluntary movements. That is to say, in the monkey the power of psycho-motor phenomena resides not altogether in the cortical centres, but somewhat also in the basilar, though to a much less degree than in dogs.

"The recognition of a psycho-motor function in the basilar ganglia implies also the notion that these centres are in direct anatomical connection with the psychic and sensory centres, and not only with the psycho-motor centres of the cortex, as is generally held. This opinion seems to be implicitly admitted by Ferrier, when he contends that in the dog deprived of his psycho-motor cortical centres the functional activity of

the corpora striata may be brought into play by emotions and ideal impressions. The psychic functions or volitional determinations may therefore, on this view, follow two routes, to be transformed into motor impulses; that of the cortical motor centres, and the more direct one of the white substance by the basilar ganglia.

"This function of the basilar ganglia is not equally developed in different animals. Thus, following Dr. Maragliano, we find that the basilar centres in man are quite devoid of psycho-motor function, which is entirely confined to the cortical. Descending from man to the monkey, and thence to dogs, cats, and rabbits, we find a progressive development of the functions of the basilar ganglia, inversely proportional to the intensity of the paralytic effects which follow destruction of the cortical centres. E. Pflüger's opinion is quite in accordance with this view. He extends the sphere of sensation and of conscious movement to the whole cerebro-spinal system, though in different degrees in different animals. Without prejudging the whole question, or committing ourselves to Pflüger's view, we are satisfied with having demonstrated a direct relation between the basilar ganglia and the psychic centres, which can excite them to action even without the intervention of the cortical psycho-motor centres.

"The compensation for or recovery from the paralytic effects of destruction of cortical psycho-motor areas is now to be explained on this view. The hypothesis of functional substitution must be absolutely rejected. We accept, however, Hitzig's view, that one part of the brain having functions identical with those of a part destroyed may by use gradually increase its own activity, so as finally to perform the same amount of labour as was normally done before the removal. This is not functional substitution, but development, and functional perfecting of an organ by means of exercise and education."

I have quoted at length both our authors' criticism of the views of Dr. Ferrier and their statement of their own doctrine, because it seemed difficult to abbreviate without obscuring the meaning of their words. No one, I think, can deny that great weight must attach to what they say. Their view seems

simpler than Dr. Ferrier's, besides which (1) the latter is not proved, and (2) Dr. F. seems to be entirely wrong in the terms in which he states it. Thus we find him saying (p. 215), "It may be confidently asserted, and perhaps it may be one day resolved by experiment, that any special tricks of movement which a dog may have learnt would be as effectually paralysed by removal of the cortical centres, as the varied and complex movements of the arm and hand of the monkey by the same lesion." The instance from which Dr. Ferrier's analogy is drawn is a most unhappy one, since we have seen that a monkey whose cortical centres had been removed three months before had quite recovered all its movements, the only change being that it became left-sided from having been right-sided. According to Messrs. Luciani and Tamburini, the dog deprived of its cortical centres would still act consciously by means of its corpora striata.

In reference to this point I should like to remark on the use of the terms "voluntary," "conscious," and the like, that we are apt to fall into error in applying them, inasmuch as we are prone to assume that the consciousness of the lower and higher animals is the same. The consciousness of a frog may not be comparable with that of a pigeon, the pigeon's with a dog's, the dog's with a monkey's, nor the monkey's with man's. An attempt has been made to escape the difficulty by arbitrarily defining consciousness from its physiological side, as the functional activity of the cerebral cells. Now even supposing this to be true of man, in whom the strongest case for the truth of the definition can be made out, is it not a bold inference to suppose that the same holds in all animals? A decerebrised man (to coin a necessary word) may or may not be comparable with a decerebrised frog. I confess that it appears to me to be exceedingly rash to reason from the one to the other. The frog's brain bears a comparatively small proportion to the rest of his nervous system. In man it is many times over heavier than the rest of the nervous system. As to functional activity, a frog seems to get on without its brain almost as well as with it; while we know how very slight an injury proves fatal in man sometimes, though it must be confessed that he suffers little from comparatively great injuries

in some other cases. Neither can we interrogate the consciousness of the lower animals as we can that of man, and if the evidence does seem to go to show that *human* consciousness has its seat in the cerebral cells, it appears as conclusively to show that dogs may be conscious by the corpora striata, and that frogs may be conscious when the brain has been removed. Dr. Ferrier appears to view as a supposition only to be entertained in order to set it aside the notion that "we must differentiate between the lower animals and man." Why should he so view it? Is their behaviour at all alike in similar circumstances? It is well known that different animals behave very differently after the performance of similar experiments on their nervous systems. What are marks of conscious as distinguished from reflex action? As consciousness in the lower animals must be an inference from observable facts, what facts would justify us in making the inference? Evidently mere adaptation of means to ends is not sufficient to distinguish between conscious and reflex acts. But surely the adaptation of new means to carry out ends not attained by setting in action the ordinary automatic apparatus justifies us in assuming consciousness? The shutting of the eye against the ingress of a foreign body is very often a reflex action. But suppose we find an animal in whom this action, though it occurred, proved unequal to the task of defending the organ; and suppose the animal then to raise hand or paw to shield the eye, should we still call this a reflex action? It seems to me to violate sound reasoning to do so. I therefore think Pflüger correct in supposing that the frog which goes through the attempt to scratch its thigh with an amputated stump, and finding this impossible, raises the opposite limb to effect the purpose, has so far proved its consciousness that no limitation of consciousness to the activity of cerebral cells can shake it. But it would yet be a great error, supposing we are compelled to assume consciousness in such a case, to infer that a dog or a man would be conscious in like circumstances. For the dog, or the monkey, or man, the inquiry must be made afresh, in each animal for its own kind, or at most for those closely related to it; and perhaps in the future we may arrive at a general definition which it does not

yet seem possible to formulate. We do not assume because we find rabbits eating belladonna with impunity that other animals can do likewise, or that mercury must act similarly on canine and human livers. And, similarly, we are not justified in inferring that homologous parts of the nervous system, even when they are found (and what of those cases in which no such parts exist?) must perform precisely the same functions. Nor is the case confined by any means either to the higher animals or the lower, to vertebrates or invertebrates. A thorough generalisation ought to be co-extensive with organisation. Are insects to be judged unconscious in all their varied manifestations because they have no cerebrum at all? The mistake of physiologists all through seems to have been that they reasoned from too small an area. Flourens' law of substitution is good for pigeons, but is altogether untrue when applied to animals in general. And in the same way it appears to me that the generalisation that the cerebral cells are the seat of consciousness in animals in general is by no means justified, because it is the case that they are so almost certainly in man.

A. RABAGLIATI.

METALLOSCOPY AND METALLOTHERAPY.

For the last thirty years Dr. Burq ('Métallothérapie,' Paris, 1853), has been endeavouring to establish a system of therapeutics in certain forms of nervous disease, based on the action of metals applied externally to the human body. His views had been generally received with coldness and even derision by his professional brethren until about two years ago, when he succeeded in attracting Professor Charcot's attention to some of his experiments. On the instance of that influential neurologist the Société de Biologie named a Commission to investigate M. Burq's statements and theories. The members of the Commission were MM. Charcot, Luy, and Dumontpallier, assisted by MM. Gellé, Landolt, and Regnard.

The points to be investigated were two: Do metals applied externally to patients suffering from certain forms of anaesthesia (chiefly of hysterical origin) bring back sensation in the parts affected and are patients severally influenced by one metal and not by others? Does the metal thus found active on external application prove equally beneficial when administered internally?

The first of these questions involves the doctrine of *metalloscopy*, the second that of *metallotherapy*, in the language of Dr. Burq.

The first meeting of the Commission was held on the 4th of November, 1876. The method followed was first to carefully examine the state of the patient to be experimented upon; then, after bandaging the eyes, to apply disks of different metals in succession, and notice the effects produced, if any. Several meetings were held, of which the details are given in the first Report of the Commission. The results may be summarised as follows:—

1. *Phenomena of Sensation*.—From ten to twenty minutes after the application of the active metal to the anæsthetic limb symptoms of returning sensation are manifested in the neighbourhood of the disks, and gradually extend to the whole of the anæsthetic region.

The special senses also, if involved, are restored in a similar manner.

It is observed that during the process the patients complain of various constitutional symptoms, chiefly headache, which is apt to persist till the next day.

2. *Phenomena of Motility*.—Patients sensitive to metals are often also amyosthenic. Observation shows that along with the restoration of sensibility there is a restoration of muscular power. When, however, contractures exist in any of the muscles, no change takes place with regard to them.

3. *Phenomena of Circulation*.—*Pari passu* with the former changes, circulation becomes more active in the affected limbs. Transfixion of folds of skin with large needles, which previously drew no blood, is now accompanied by hæmorrhage. The temperature of the limb is also shown by the thermometer to rise with the increased supply of blood.

4. *Phenomena of Transference*.—The members of the Commission, whilst engaged in studying the facts stated above, discovered that all the changes on the side of the body operated upon occurred, so to speak, at the expense of the opposite side. That is to say, while sensation, muscular strength, and circulation were restored on the one side, they vanished in a proportional degree in the corresponding part on the other side of the body.

It was observed that all these phenomena were strictly transient. In no case did the effects produced last more than a few hours, and patients experimented upon day after day never showed any signs of permanent or real amendment. Strange to say, however,

Professor Charcot, having tried the application of metals in two cases of organic hemi-anæsthesia, obtained a permanent return of sensation. In the one case, that of a woman affected with hemi-anæsthesia and hemichorea from cerebral lesion, zinc, copper, and gold proved ineffectual. Iron, however, applied for twenty minutes, caused symptoms of returning sensation, and the patient continued to progress until feeling was restored to the whole side of the body. A local application of iron disks caused the return of gustatory and olfactory sensation on the affected side. The hemichorea was also notably diminished by the treatment.

Having arrived at the facts just described, the Commission proceeded to investigate the possible electrical nature of the action of metals on the organism. When two plates, placed in contact with the patient's skin, were connected with the terminals of a multiplying galvanometer, a deflection of the needle was constantly produced. The amplitude of this deflection varied with the metals used, measuring from 2-10 degrees with gold plates, and from 8-15 degrees with copper plates. It was then found that battery currents equal in strength to those indicated by the plates had the same effects as the plates themselves. Further experiments showed that if the current-strength went beyond that given by the metal to which the patient was sensitive, no effect whatever was produced. (It is to be noted that all these currents were so weak as to be comparable only to the "physiological currents" of nerve and muscle, and demonstrable only on galvanometers with 30,000 turns of fine wire.) Beyond a certain point, however, it was found that increase of the current was followed by the usual phenomena of return of sensibility, &c.; and repeated observations allowed the rule to be laid down that each patient was sensitive to certain current-strengths, but not to intermediate ones. Such ineffective points in the galvanometric scale were called "neutral points." For instance, a patient who proved sensitive to a current of 2° was also sensitive to currents of about 40° and 70° , but insensitive to currents between these several points.

Such were the conclusions reached by the Commission, and embodied in the report presented by them to the Société de Biologie on the 14th of April, 1877. They then proceeded to investigate Dr. Burq's second proposition with regard to the therapeutical application of the metallic sensibility of certain patients, and to ascertain whether the metal, active externally, acted curatively upon internal administration.

Their second report, read on the 18th of August, 1878, begins

with a recapitulation of the facts previously established, and gives the details of the following cases:—

1. M., sensitive to gold. On July the 11th one-third of a grain of chloride of gold was administered daily. In about three weeks the anæsthesia and amyosthenia had disappeared; menstruation had begun to take place normally, and the general state was altogether satisfactory. On August the 23th gold plaques were applied. Sensation, both general and special, gradually vanished. After one hour and a quarter the plaques were removed, and sensation returned within nine minutes to the various parts, in an inverse order of that of its disappearance.

2. A., blind; restored to normal health by chloride of gold in doses of one-third of a grain, gradually pushed to nearly one grain. Gold plaques applied; within half-an-hour anæsthesia and amyosthenia induced, together with phenomena of dysesthesia, sleepiness, loss of memory of persons and things. On the removal of the disks she seems to awake, and asks to go away. The restoration of sensation proceeds with great rapidity.

3. B., sensitive to copper. Improves greatly under the influence of pills of binocide and albuminate of copper. But the drug ceases to be tolerated by the stomach after three weeks, and the treatment suspended, and anæsthesia returns. A month afterwards patient is made to drink the St. Christan water (which contains copper). Improvement becomes manifest, and two weeks after, the copper plaques are applied: similar phenomena are observed as in the previous cases, anæsthesia, amyosthenia, and sleepiness are induced, which disappear after the removal of the disks. Subsequently her state was found to have gone on improving under the influence of the mineral water.

4. B., sensitive to gold. The patient is a hystero-epileptic, anæsthetic on the right, analgesic on the left. A treatment of aurum chloride was instituted; all the hysterical symptoms disappeared, and menstruation became regular, whilst the epileptic fits continued.

5. W., completely anæsthetic; amyosthenic. The gold, exhibited internally, restored sensation and muscular power, and for a month she had no hysterical fit.

Several of the experiments performed in the above cases were witnessed by Professors Claude Bernard, Vulpian, Bécлар, and other physicians.

The report draws attention to the fact that the same patient may be sensitive to some extent to more than one metal, but if

metals to which she is not sensitive are substituted without her knowledge, no phenomena are produced. This, it is maintained, excludes the action of expectant attention invoked by some in explanation of the supposed metallic action.

Further experiments were instituted, showing that the weak galvanic currents above described acted here also as the plaques. Platinum disks too, which are inert when applied without preparation, become active when charged by connecting them with the poles of a galvanic battery.

Another curious series of phenomena studied by the Commission was the effect of the combination of metals applied externally. It was found, for instance, that if a gold plaque was applied to the patient, and a silver plaque superposed, when sensation had returned the effect was *fixed*, as it were, and anæsthesia did not return within the usual limits. Next, that if the two metals were applied, already superposed, no effect followed; and that the same happened if a silver disk was applied above the gold one, or even on the other arm. As an illustration of this, mention is made of an experiment on A. (sensitive to gold). A gold plaque fixed to a wooden disk did not produce the accustomed effects. On inspection it was found that copper clamps had been used for fixing the gold to the wood. The substitution of gold coins was immediately followed by anæsthesia. The report also draws attention to the case of Mlle. M., who, among some hysterical symptoms, was affected with achromatopsy. She was cured by the administration of gold chloride. But it was found that the application of the gold plaques to the temple immediately reproduced the achromatopsy; the loss of perception of the various colours following an order opposite to that in which she had regained it previously: thus, violet, red, orange, yellow, blue, were successively lost.

The conclusions reached by the Commission naturally drew a considerable amount of attention to the phenomena of metalloscopy. Numerous illustrative cases appeared in the medical periodicals, of which the following may be quoted:

1. (Burq, 'Gaz. des Hôp.,' Nos. 102 and 105, 1878.) A young woman, who had during four years been treated in various hospitals for severe hysterical symptoms, was admitted into l'hôpital de la Pitié, under Dr. Dumontpallier. Everything had failed, including electricity, and even surgical interference. She presented left-hand anæsthesia, with paresis, anorexia, constipation, meteorism, and amenorrhœa. The left leg was highly hyperæsthetic, and the seat of a contraction of the flexors.

She was found to be sensitive to gold chiefly, but also to copper. The application of gold plaques relieved the anæsthesia and hyperæsthesia, together with the contracture; their effect seemed, however, to last only so long as they remained applied. On their removal, the patient returned to her previous condition.

She was treated by subcutaneous injections of gold chloroxyde with such success that in two months most of her symptoms had subsided. The application of the plaques, however, still produced troubles of sensation; a fact, in Dr. Burq's opinion, which proves the persistence of the "hysterical diathesis," and forbids, as long as it subsists, to consider the cure as complete.

2. In the same hospital, last summer (see 'Gaz. des Hôp.,' No. 87), there was a married woman who, since 1870, had been subject to hystero-epileptic seizures. These occurred as often as three times daily. Her general health was bad; she suffered from intense vaginism; and it was found on investigation that the cervix was imperforate, and that menstruation had been vicariously carried on by hæmorrhoids, which bled regularly every month. For eighteen months, however, there had been suppression of this flow.

She was found sensitive to silver plaques. Accordingly, silver was administered internally. After a few days the piles began to bleed, and her state gradually amended.

3. A patient was admitted, under Dr. Dumontpallier, for rheumatism of the knees. She was a quiet woman, married, and had had only one hysterical fit, due to mental shock. This appeared a suitable case to test susceptibility to metals; and accordingly gold, silver, iron, and zinc plates were applied successively, but in vain. At last copper was tried, and produced anæsthesia of the limb, transient as is usually the case, but which could be "fixed" by the application of one of the neutral metals, such as iron or zinc. Several experiments were made, giving the same results. It was further noticed that on repetition of the applications severe cephalalgia supervened, of a persistent nature; and that hysterical fits manifested themselves more and more frequently. On discontinuation of the experiments, the patient returned to her previous state. (See 'British Medical Journal,' Oct. 12, 1878.)

4. Dr. Burq showed a patient, at a meeting of the Société de Biologie (May 11th), who, after having been sensitive to gold, was no longer influenced by that metal. Silver produced some effects, but of fleeting character. On the superposition of a plaque of an alloy (zinc, copper, nickel) persistent effects were obtained.

5 to 7. Dr. Vigouroux finds ('Progrès Médical,' No. 30) that a

neutral metal fixes the change produced by other agents than the plaques, such as magnetism or electricity. He describes a case of left hemianæsthesia in which transfer was produced by a charge of statical electricity. A brass plate then attached to the left arm fixed the effect; and next day the right side was anæsthetic and achromatoptic. In a second case brass was found to fix the effect for a whole day. In another, copper preserved æsthesia for a whole week. Here the experiment was repeated several times successfully. The anæsthesia returned immediately upon removal of the metal.

8. Dr. Abadie ('*Progrès Médical*,' No. 28) states that amblyopia is often hysterical, and then accompanied by a low degree of anæsthesia, of which the patient is not conscious. The hysterical kopiopia of Förster ('*Hdbch. ges. Augenhilkde.*' vol. vii. p. 88) is characterised by photophobia, peri-orbital pain, cephalalgia on reading, painful sensations in eyelids and conjunctiva, and is dependent either on actual uterine trouble or pure hysteria. In these ocular disturbances the application of metals is of importance.

Mlle. Z. complains of kopiopic symptoms every morning; the eyelids are puffed. Chalybeates, hydrotherapy, the bromides, quinine have been tried in vain. Gold plaques are applied overnight to the temple, and gold chloride exhibited internally for a month. No result followed this medication. Copper plaques were then substituted: after the first night there was some improvement; the puffiness had not appeared. After eleven days the patient can read for one hour. In one month she thinks herself cured and gives up treatment. All her old troubles soon return, however, and she resumes her copper applications. She is dismayed to find that this time not the slightest result is obtained. She returns to Paris, where copper with zinc superposed is tried. The symptoms give way and have not returned since.

Prof. Westphal, having witnessed some of the experiments performed at the Salpêtrière, made some observations, the results of which he read before the Medical Society of Berlin on the 5th of last June. ('*See Berliner klin. Wochenschrift*,' No. 30, 1878.) Among some preliminary remarks, we observe that he objects to the term "ovarian hyperæsthesia," so often used in connection with hysterical symptoms. For he had some patients specially examined, and it was found that pressure upon the ovary from the vagina did not produce any pain, whilst external pressure did. The tenderness therefore resides in the abdominal walls and not in the ovary itself. The first case he describes is one of left

anæsthesia in a hysterical patient. Two florin pieces having been applied, the patient discovered "with terror" some time afterwards that sensation had returned. No transference was observed in this instance; but it was so four days afterwards during another application, which was followed by a persistence of sensation, lasting until a fit occurred five days afterwards.

2. Hemianæsthesia, in a non-hysterical patient, after attempted suicide with chloral. Silver plates are fixed to the ulnar side of the hand; subjective sensations are felt, and there is return of feeling in little, and ulnar side of ring, finger. This was not permanent, and further attempts proved unsuccessful.

3. Hemianæsthesia. The patient proved sensitive to gold in two experiments. Later, iron gave similar results.

4. Left, and partial right, anæsthesia. A small galvanic element made of zinc and brass, with a wet piece of lint between, is applied by its zinc-side face to the skin. Sensation returned. A magnet was then tried, with the N. pole centrally: sensation returned in ten minutes at the S. pole, in thirty at the N. pole, and a little later at the neutral point of the magnet. Further experiments showed that the S. pole always acted more energetically.

Prof. Westphal then tried disks of copper, with a layer of varnish or sealing-wax to protect them from any action from the moisture of the skin, and obtained similar results. Even ivory markers were successfully applied to a patient. Finally, several observations showed that mustard-plasters produced a return of sensation at their seat of action.

In the wards of Dr. Wilks, at Guy's Hospital, some observations were made which are recorded in the 'British Medical Journal,' July 10th, 1878.

CASE 1. E. M., school teacher, whose symptoms "fluctuated between sickness, rheumatic pains, analgesia, anæsthesia, &c., the incontinence of urine remaining," was submitted to various metallic applications, but in vain.

2. C. B., analgesic on left side, the special senses being affected on the same side (deafness, achromatopsia).

On the 21st of February two sovereigns were applied to the forearm. In twelve minutes sensation had returned under the loins; this gradually extended upwards to the shoulder. The points at which the skin had been pricked bled copiously subsequently. Some indications of transfer were observed. The night after the experiment, the patient suffered from an intense headache. Two days after, lead and iron were applied with some, but rather

indistinct results. The return of sensation was very limited in area, and occurred after thirty minutes only. Transfer was not observed with the lead plaques. On the 26th gold was again tried with much more marked effects, but not so clearly defined as at first. The patient was put on one-eighth of a grain of chloride of gold and sodium three times a day without her knowledge. Two months after, she had recovered to a great extent, being able to move about freely. The special senses had fully recovered; there was amyosthenia in the left side, however, and anæsthesia in the hands and feet, extending about half way up the legs and forearm.

Dr. A. H. Bennett, who has published views on metallotherapy in the last number of this Journal, gives the details of experiments on a case in the 'British Medical Journal' for Nov. 23, 1878. The patient, aged 44, single, had nine years previously had an attack of transient paralysis of the right arm and leg and twisting of the face to the right side, apparently as if there were paralysis of the left. She soon recovered; but four years afterwards she began to become numb and weak on the right side. She again had an attack similar to the first, which passed off, leaving, as found on examination, impairment of muscular power and anæsthesia, both general and special, on the right side of the usual kind. There was an apparent absence of all nervous or hysterical symptoms. Various metallic disks were applied in succession time after time, but without any result, until one day she was found to have recovered sensation in the right arm, under zinc. The sensation ultimately become restored over the whole body, the left side even being hyperæsthetic. Next day the anæsthesia had returned as before. Similar results followed six or eight subsequent experiments, but the analgesia of the right side gradually became less, while there was a corresponding blunting of sensation on the left, so that eventually both sides were in the same condition.

All kinds of metals now produced the phenomena due first to zinc, but sensation never extended beyond the limbs to which they were applied. Even wooden disks were now found to answer as well as the metallic ones. The state of the patient became one of great instability with regard to the anæsthesia, which was present now here, now there, and the applications were now no longer followed by any constant results.

The patient went for a month to the seaside, and on her return was found much in the same state as on admission, except that the sensibility of her right arm had improved, while that of her left side had diminished.

In a thesis for the M.D. of Paris, just published, entitled '*Comparaison des effets de divers traitements dans l'hystérie*,' &c., Dr. Oscar Jennings gives a historical sketch of the use of metals in ancient times; which is followed by an analysis of three cases of metalloscopy taken from periodicals, in which the observations had been published.* After a short notice of the electrical theory of metalloscopy, Dr. Jennings proceeds to give his own explanation of the phenomena, which he looks upon as purely the effects of imagination. These are illustrated by the well-known tales of middle-ages delusions. After urging that the effects of metal plaques are not constant, that the sensitiveness of the same patient varies, and that doctors differ among themselves as to the relative value of different metals, the author maintains that in every case the patient *knows* what metal is applied, that this knowledge works upon her imagination, and thus the effects are produced. The initial impression of a particular metal is due to chance, fancy, &c. The patient recognises the metal either by *smell* or a peculiar exaggeration of tactile sense at the point of contact which enables her to diagnose the nature of the plaque.

In offering such an explanation, without a single experimental proof in support of it, Dr. Jennings certainly appears to me to make as severe a demand upon the imagination of his readers as he does upon that of the patients. Under the hypothesis of an electrical action of metallie plates, the inconstancy of the phenomena observed may be explained by the fact of the same metal giving in different individuals, and in the same individual at different times, signs of varying electrical states. That such is the case has been shown by Eulenburg in the '*Deutsche medicinische Wochenschrift*' (Nos. 25 and 26), where he gives the details of some galvanometric measurements of the electrical action of plates of different metals applied to the skin.

Dr. Thérpes has published the results of his experiments upon the application of heat and cold, in similar cases to those in which metals produce the effects previously described. (See '*France Médicale*,' No. 69 ff., and '*Gazette des Hôpitaux*,' No. 123.)

Hysterical patient, with left hemianæsthesia, achromatopsia, and amblyopia, which prevented her reading any of the twenty Nos. of Jäger's scale.

Ice to left temple: achromatopsia disappears; patient distinguishes first blue, then yellow, red, green, violet; and can read No. 2 of Jäger's scale. Transference occurs. On removal, return of anæsthesia, &c., in opposite order.

Ice to left arm: anæsthesia and amyosthenia of arm transferred to right. Prolonged application produces "anesthésie de retour."

Cold water produces similar phenomena, but less marked.

General cold douche: effects the same, but generalised.

The effects of heat were the same; the methods being the application of warm water to the hand, a hot sponge to the face, and a general hot douche. The temperature used ranged between 40°–50° C.

Statical electricity was also tried successfully: magnets had no effect. Other cases gave similar results.

On the 6th of June, 1878, Professor Charcot introduced before the Société de Biologie the subject of magnetism and the influence of magnets upon the nervous system in certain diseased conditions; prefacing his own remarks with a short historical sketch of the subject. In 1779 the notorious Mesmér appears to have obtained some results from the application of a magnet to a hysterical patient. He repeated his experiments before two friends, one of whom was a physicist, named Ingenhousz. Instead of pursuing his researches in a judicious and scientific spirit, he forthwith launched into wild hypotheses, after proclaiming the existence of an "animal magnetism," and readily obtained a hearing from credulous people. Ingenhousz opposed these extravagances; and Andry and Thouret published forty-eight observations, which, if not sufficiently critical in their spirit, still show that some remarkable results were obtained. Mesmerism, however, was doomed to fall through its own excesses; and little more was heard about magnets till the publication of Becker's work, 'Der mineralische Magnetismus und seine Anwendung in der Heilkunst,' published in Muhlhausen in 1829.

The next writer who appears in the field is Professor Maggiorani, of Rome. His views are contained in a pamphlet, published in Milan, in 1869, 'La Magnete e i Nervosi,' and in two communications to the Reale Accademia dei Lincei (Sessione VI., del 5 Maggio, 1872, and Sessione II., del 5 Gennaio, 1873). His experiments were made with weak magnets, sometimes rotatory, and solenoids, in various forms of nervous disease, organic or functional. He also obtained marked effects from the application of magnets to cats. He found hysterical, ataxic, hemiplegic, diabetic patients, frequently sensitive to the action of magnets; but never speaks of having obtained any prolonged or curative effects.

The main symptoms elicited in successful cases were sensory disturbances, convulsive or spasmodic phenomena, and rise of

temperature. He gives a table of the cases in which the thermometer showed an increase, amounting to sometimes $\cdot 2$ and even $\cdot 4$ Centigrade, after the application of magnets.

Professor Charcot's own observations were made with solenoids (that is, coils of insulated wires through which an electrical current circulates), with ordinary magnets, and with Faraday's powerful electro-magnet, fed by fifteen Bunsen's elements. The cases he exhibited to the Société were the following:

1. A., blind, hysterical, hemianæsthetic. When the neutral point of the magnet is applied, no effect is produced; when one of the poles, there follows the usual phenomenon of transfer. If the application is protracted, there occurs a reversion to the usual state of things. Upon removal, there occurs another transfer, soon followed by another reversion to the primitive condition.

2. G1. The patient's arm is placed in the solenoid, and the current made: transfer, and later reversion. The same phenomena occur now on breaking the current.

In some hysterical cases these changes occur with the utmost rapidity.

3. A man affected with organic lesion of the brain, and hemianæsthetic. The electro-magnet was applied to the anæsthetic arm. In twenty minutes sensation had returned to the whole side. No phenomenon of transfer was observed. Apparently the cure is permanent.

Many hundred of times, says Professor Charcot, these experiments have been repeated in private and hospital practice, with similar results.

Dr. Vigouroux reports a case in the 'Progrès Médical' (Nos. 35 ff., translated in the 'London Medical Record' for November), in which Professor Charcot applied magnets in a very original, and so far successful, manner. The patient was hysterical, and suffered from a most severe contracture of the flexors (together with anæsthesia) of the left arm. A pad had to be placed in the patient's clenched hand, to prevent the nails from burying themselves in the palm. The application of metals to the diseased arm, as well as of solenoids, magnets, electrical currents, both induced and constant, had proved utterly useless; but it was found that a solenoid to the right arm had the effect of rendering it analgesic and cold.

On the 12th of June a magnet was applied to the back of the right arm. Analgesia and cold extend into hand; marked flexion of the fingers. After one hour the left hand can be opened with less force. Temperature of right arm, $27^{\circ} 6'$; of left, $30^{\circ} 4'$. The

contraction of the right hand and fingers becomes more intense, and is removed by faradisation of the extensors.

15th.—Magnet to flexors of right arm. Similar phenomena occur. The contraction produced cannot be wholly removed by faradisation.

17th.—Right hand still weak. No magnet is applied. Extensors of left arm faradised. It is found that sensation has returned in left thumb.

18th.—Magnet to right arm, which remains analgesic and weak, notwithstanding faradisation. Faradisation of left extensors; return of sensation in little finger. Contraction diminishes.

Further progress on the 19th. On the 21st the left arm has recovered sensation in parts. The magnet no longer produces cold, but hyperæmia in right arm. Treatment continued till the 4th of June, when the magnet was applied to both arms, which remained contracted till the evening. The left then returned to its state before the application; the right remained very weak.

11th and 12th.—Magnet applied to both arms. A brush discharge of statical electricity restored flexibility and sensation to the remaining anæsthetic regions of the left arm. Voluntary motion of left thumb manifests itself. On the 23rd of July slow voluntary movements of left fingers and wrist were possible. The right arm was still weak.

As Mr. Charcot remarked, there was in this case a "predisposition" to contracture. Application of magnets produces such phenomena only in cases where such a predisposition is present. There is a curious correlation between the transfer of anæsthesia and transfer of contracture; the mechanism in both is probably similar. It has been seen that in this case the most varied means directed to the diseased limb did not produce the slightest result; as a rule it will be found better to act upon the sounder side, both for diagnostic and therapeutic purposes. There has been no transfer of sensation here, which shows that it is not a constant phenomenon in hysterical cases. On the other hand, a case of hemi-anæsthesia from syphilitic cerebral lesion did present the phenomenon as well as the peculiarity of a gradual recovery, instead of the immediate one, observed usually in organic affections. (There was, by the way, an improvement of the concomitant hemiplegia with athetosis.) It is to be observed also that transfer may occur separately as regards (a) sensation, (b) muscular power, (c) vascular tonicity, (d) temperature. Contracture of the flexors was always produced, whatever the position of the magnet was. In the leg,

contracture could be produced in the peronei, or in the flexor (gastrocnemius, &c.) muscles according to that position. *Galvanic currents* were found to produce contracture, as well as magnets. Unipolar action of a battery of 80 Daniell-Trouvé cells produces it also. Charging the patient with static electricity, or acting upon the flexors by means of sparks sufficient to produce single contractions, does not produce contracture. The "brush-discharge" of static electricity directed on the same muscles produces it. (This clearly shows that what is required from electrical applications is not a "current," nor "interruptions," but simply a *steady, local*, difference of potentials.) Ice applied locally produces contracture. Many experiments have shown that vibrating sonorous bodies applied to the arm of hysterical patients act as metals, magnets, &c. In the present case a large diapason was used, contained in a case 1.20 metre broad, .40 long. When the patient's hand rests on the case, contracture is produced, but not if the patient sits altogether upon it.

Test experiments were also tried: the neutral point of magnets, simple metals, insufflations with an atomizer (imitating the sensation of the brush-discharge), were all fruitless.

The practical outcome of all this is, first, the possibility of producing artificial contracture; second, the beneficial influence of such proceedings upon the original contracture. Apart from all theoretical considerations, these results are valuable, therapeutically, as giving some hope in an otherwise very intractable manifestation of hysteria.

The phenomenon of transfer which the experiments of the French Commission have so strongly brought into light had, it is curious to note, been already observed by Dr. Buzzard ('Practitioner,' October 1868) under the following circumstances. A girl of about fourteen suffered from seizures, apparently epileptic, which were preceded by an aura in the *left* wrist. A blister applied to the forearm arrested the aura, the fits became less frequent, and were then heralded by an aura originating in the *right* wrist. Eventually the aura returned to its former seat, and one or two fits a week continued to occur, uninfluenced by treatment. At twenty years of age the patient died of acute phthisis. The sole lesion discovered in the brain was a small gliomatous tumour, the size of a walnut, situated in the white substance of the left hemisphere above the middle of the lateral ventricle. Dr. Gowers, who relates the results of the post-mortem examination ('British Medical Journal' September 26, 1874) remarks that beside the interest due to the fact

that the aura (and probably, therefore, the convulsion) arose on the same side as the lesion, the migration to the opposite side in an organic brain disease is certainly a rare event. This case has a historical, as well as an intrinsic, importance in connection with the subject now in hand.¹

Intimately connected with the phenomena of metallic and magnetic sensibility in hysteria, and tending to throw much light upon the difficult problems they raise, are the facts lately described and demonstrated by Professor Charcot. (See 'Gazette des Hôpitaux,' No. 135; and 'British Medical Journal,' October 12th, and November 30th). By looking fixedly at a hysterical patient it is possible to throw her into a state of lethargy, characterised by unconsciousness, insensibility, and complete muscular resolution. Whilst in this state she manifests a most extraordinary degree of muscular excitability. If the region of the facial nerve, near the ear, is touched lightly with a wooden rod, all the facial muscles on that side are thrown into a state of violent contraction, just as if a strong faradic current were used. If the sterno-mastoid or any other muscle be touched singly in the same manner, it is also made to contract. It is evident that no patient can possibly feign these results unless acquainted with anatomy and physiology. Repeated stimulation with the rod converts the single contraction into a lasting contracture.

Opening the eyelids of the lethargic patient so as to expose the retina to the impression of daylight makes the patient pass from lethargy into catalepsy, with plastic rigidity of the limbs. Blowing in the patient's face or pressing upon the ovarian region at once draws her out of her unconsciousness, and it is then found that the contracture induced persists. To dissipate the latter, it is sufficient to reproduce the lethargic state and stimulate the antagonistic muscles. The cataleptic state can be produced immediately by making the patient look at the electric light. When the light is turned off she passes into the phase of lethargy with its concomitant phenomena. Whenever she is roused from this pathological state she utters a cry and foams at the mouth.

Professor Charcot also pointed out that in hysterical women who have not had any fit for some time there are hyperæsthetic points on the body constituting hysterogenous zones comparable to the epileptogenous zones described by Brown-Séquard in guinea-pigs.

¹ Dr. Dumontpallier ('Soc. de Biologie,' No. 30) states that in healthy individuals there often occurs a diminution of sensibility and temperature on the opposite side of the body when a portion of an arm, for instance, is anaesthetised by means of the ether spray. As in cases of hysterical transfer, this diminution occupies a corresponding symmetrical surface.

The most common locality of such points is between the shoulders; they are also observed in the axillary region and about the waist. Light pressure or friction calls forth an attack; more energetic or protracted stimulation arrests it.

In presence of the novel, nay startling, nature of many of the facts related above, one naturally finds some difficulty in framing a hypothesis to explain them; and more difficulty perhaps still in following the wiser course of abstaining from any definitive judgment until more is known about the subject. I trust, however, I may without presumption offer a few remarks of a general character.

1. The attitude assumed by some writers on this subject, and described by them as one of "strict scepticism," is in my opinion one rather of prejudiced dogmatism. The true "Cartesian doubt" is very different from the active disbelief so often mistaken for it. We hear the theory of a metallic or magnetic action upon obscure derangements of the nervous system dismissed summarily as "long exploded." Exploded by whom? When were the phenomena subjected to a searching scientific investigation? A hundred years ago Mesmer by his disreputable practices threw *discredit* upon the whole subject, but there is not one atom of *proof* to show that magnets and the like can never influence the human organism. There is no innate improbability that a physical force like magnetism, closely connected as it is with electricity, may influence it, and the facts before us at least make further inquiries an imperious necessity.

2. Naturally enough "expectant attention," the *Deus ex machina* of the physiologist in trouble, has been made responsible for all the phenomena attributed to metallic and magnetic influence. That it may and does explain much, is a proposition which will not be denied. But that it explains all, is one that requires more conclusive argument from those who hold this view. The character of the observers who vouch for the facts recorded, and the strained meaning put upon the expression "expectant attention," in order to make it account for all the phenomena, make us cautious in accepting too readily a theory that seems to be merely a screen for our ignorance.

3. Such proof is supposed to be furnished in respect to "metallic influence" by the fact that other bodies, such as wood, are productive of the same results as metals. Now it may be admitted by all except perhaps by a thorough-going Burqist, that metals, as such, have no specific influence; that their action may be electrical, not dynamical, but statical. If this is true, it is obvious that nothing is proved by the substitution of wood for metal, since, as everybody knows, a disk of wood applied to the skin will be at a

different potential from the body, and though unable to give rise to a current, will, as well as any metal, exert a statical influence upon the tissues beneath. At the same time it is possible that, in Dr. Bennett's case, expectant attention formed a factor in the later stages, when after a few successful applications of metals the patient had learnt what to expect. The gradual weakening of the effects noticed in the same case may as well be explained by the wearing-off of the therapeutical virtue of the treatment by undue prolongation, as by the tiring-out of the patient's attention. At any rate, many more such observations upon a variety of cases, and with special reference to the electrometric conditions, will be necessary to invalidate the numerous antagonistic cases recorded elsewhere.

4. It is a curious fact, too, that the application of disks, metallic or wooden, should have such a very marked influence upon the imagination of the patient. It would seem that the more striking application of electricity, from an induction coil, for instance, ought to enlist as much interest on her part, and act as powerfully upon her psychical faculties. In the Salpêtrière patients, injured as they were to the most varied experiments, we yet find the simple application of metal plates invariably successful. Again, however imaginative hysterical patients may be, we find that in them the effects are but transient; whilst in old standing organic lesions permanent cures are effected. And how do we explain transfer of insensibility by expectant attention? Warts removed by "charming" are not reproduced on the other side of the body. Entirely *unexpected* results can hardly be put to the credit of expectant attention, especially when they occur in a large number of cases.

5. The objections made to experiments with metals cannot be applied to those performed with electro-magnets and solenoids. For in the latter there is nothing to indicate to the patient that a current circulates in the coil of wire. And yet it is found that the mere application of the apparatus is not followed by any manifestation, but that the effects follow only when the current is sent through the wires, which is easily done, entirely without the patient's knowledge.¹

¹ Dr. Carpenter ('Brit. Med. Journal,' Dec. 14, 1878) "cannot but wonder that Prof. Charcot and his reporters should have so readily accepted the reality" of the phenomena above described "without taking those precautions which experience has shown to be necessary for the elimination of the influence of expectancy," and he mentions the desirability of testing them "by means of electro-magnets made and unmade at a distance." Dr. Carpenter, like many other English critics, appears to be unaware of the methods used, and number of experiments made, by Prof. Charcot. The public demonstrations at the Salpêtrière are intended to *illustrate* his results and not to *prove* them.

6. It is admissible to suppose that, under given circumstances the nervous system may become more sensitive to electrical influences, as it does become more sensitive to other agents, such as light, sound, &c. That the human system is influenced by static electricity is proved by the fact that many people of "nervous" temperament are highly sensitive to changes of atmospheric potential. Dr. Lombard has shown ('*Climatologie Médicale*,' vol. i., p. 410) that mortality and electrical tension rise and fall together. Professor Scoutetten ('*De l'électricité dans les eaux minérales*') has given reasons for assuming that mineral waters owe their efficacy more to their electrical actions than to their actual composition. That terrestrial magnetism may have also an influence upon our bodies is far from improbable, and Dr. Horn ('*Ueber Krankheits-Erzeugung durch erdmagnetische, &c., Einflüsse*') has tried to establish some connection between the appearance of certain diseases and magnetic fluctuations. M. Grandean has found ('*Acad. des Sciences*,' July 1878), and M. Berthelot confirmed the fact, that plants can be arrested in their growth by disposing about them a few iron wires. Here, at least, as in Dr. Maggiorani's cats, there is no room for the influence of the imagination.

7. Having thus cleared the ground so far from the main obstacles to a calm view of the subject before us, I may sum up the whole question by saying that, under certain disturbed conditions, the nervous system appears to be sensitive to influences, various in their nature and obscure in their mode of action. The facts are too numerous and too well supported to be doubted; the explanations of the facts hitherto given are not sufficiently supported by experiment to be regarded as satisfactory. Whatever the fate of metallic and magnetic therapy may be, there is not the slightest doubt that the researches to which they have given origin will be followed by a rich harvest of pathological discovery in a very important and obscure field of medicine. All honour is due to Professor Charcot, who has had the courage to brave the charge of reviving "played out and flimsy superstitions," and has preserved whilst treading on such dangerous ground a spirit of admirable reserve and penetration. To the sciolistic "esprit fort," which delights in cheap scepticism, I prefer the scientific humility of a Claude Bernard, who, in presence of the strange facts he was witnessing, confessed his ignorance:—"Malo cum Platone errare!"

A. DE WATTEVILLE.

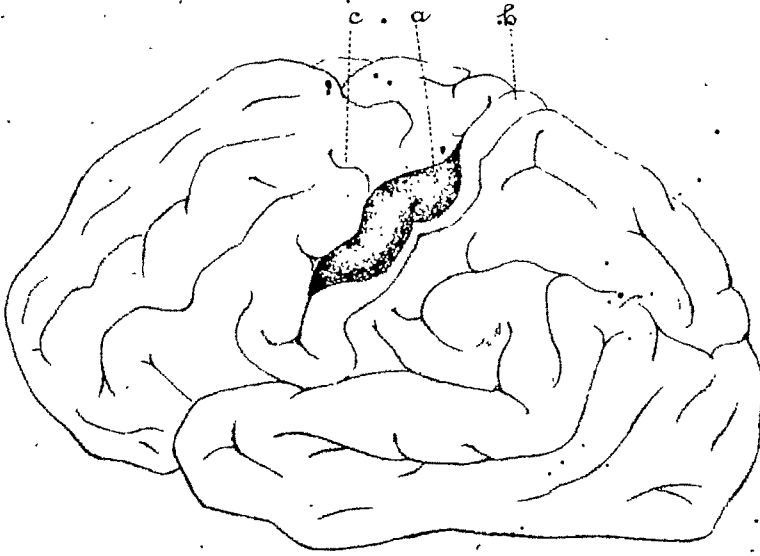
Clinical Cases.

GENERAL PARALYSIS AND CEREBRAL TUMOUR, WITH ATROPHY OF THE ASCENDING PARIE- TAL CONVOLUTION OF THE LEFT HEMI- SPHERE—NO PARALYSIS ON RIGHT SIDE— CONVULSIONS ON LEFT.

BY DR. MAGNAN,

Médecin de l'Asile Ste. Anne, Paris.

M. M. ^{re} L., housekeeper, aged 48, was admitted into the Asile Ste. Anne, on October 30, 1878. This woman, whose hereditary antecedents had nothing remarkable, and who had uniformly enjoyed good health, had been married a second time at the beginning of 1870, having had a child by her first husband, which died at the age of six months from some inter-current affection. The menopause seems to have occurred previous to the second marriage. In November 1870 there occurred for the first time an epileptiform attack, followed by five others almost without intermission. They extended to the whole of the left side, arm, leg, and left side of the face; but left no paralysis either on the left or right. From this time the attacks occurred irregularly, sometimes strong, sometimes feeble, but in general more frequently. They were always on the left side. No paralysis remained after the convulsions. From 1870 the intellectual faculties began to be impaired, her memory failed; and though she could attend to the duties of her house, yet she required to be looked after by her husband. The moral and affective faculties also became degraded. The patient was apathetic and totally indifferent to her deficiencies, or the reproaches which were at first addressed to her. At times she seemed satisfied and content, notwithstanding all her troubles. In 1876 the convulsions were accompanied occasionally by excitement, and in 1877, at the end of a series of attacks, the patient was seized



Description.

M. Magnan's Case of General Paralysis with Cerebral Tumour.

- (a) Angiolithic Sarcoma
- (b) Atrophy of the Upper two-thirds of the ascending Parietal Convolution.
- (c) Ascending Frontal Convolution.

with a maniacal outburst, for which she was sent to the Asile Ste. Anne.

Discharged at the end of five months at the request of her husband, she was found utterly unfit for her duties; and after a return of mental excitement she was again sent to the Asylum. On her admission in October 30, 1878, she seemed in an advanced stage of dementia. Her memory was impaired, and she had a satisfied and contented air. She stated in a childish manner that she had much money, that she could make beautiful boots, that she was very clever, had lovely eyes, and that she was very pretty. Her speech was hesitating. The left pupil was larger than the right. She remained in the same state for three months, and then became turbulent. She was excited, heard the voice of her parents and husband, and was seized with epileptiform convulsions, followed by coma, in which she died on November 26.

Autopsy.—The calvarium was thick, the diploë red and injected throughout. The dura mater was slightly injected, but there were no false membranes. The arachnoid and pia mater were thickened, cedematous, opalescent, and adherent to the right hemisphere throughout, both anteriorly and posteriorly. In the left hemisphere there were adhesions on the frontal lobe and the occipital lobe, but in the middle region the membranes were easily separable from the ascending frontal, parietal, and temporal convolutions.

In the left hemisphere also, about the middle of the fissure of Rolando, an elongated tumour was visible, following the direction of the fissure, above downwards, and before backwards. It was slightly indented, and was partially overlapped by the ascending frontal convolution, but posteriorly rested on the ascending parietal convolution, which it compressed, and which at its upper two-thirds was reduced to about a third of its volume. (See Lith. Plate.) The tumour deeply invaded the fissure of Rolando, reaching the white substance after having destroyed the pia mater and the cortical substance. The tumour (Angiolithic Sarcoma)* had a reddish-grey tint, and of the size of an almond. It was of oval shape, the larger extremity being directed upwards. It had a resistant fibrous capsule, and another layer, greyish, thin and soft. The contents were yellowish and caseiform, soft, but here and there cretaceous and resistant. In the larger extremity of the tumour, attached to the internal surface of the fibrous capsule, there was a small fusiform mass, 1 cm. long, and 4 mm. broad. The larger portion exhibited stratifications arranged round a central resistant nucleus of a pearly-grey. The successive

* See Cornil et Ranvier, 'Manuel d'Histologie,' vol. i. p. 183.

layers became more and more white from within outwards. The centre consisted of a glomerulus of vessels, and the wall, when examined microscopically, was seen to be transformed into a homogeneous vitreous sheath, with small transverse fissures, like those of fractured glass. In the preparations taken from the periphery of the small ovoid mass, there were numerous crystals of cholesterine. These were also found in large numbers among the fatty and granular material of the caseiform contents of the tumour.

The cortical substance in contact with the tumour, at the bottom of the fissure of Rolando, exhibited sparsely scattered cortical nerve cells which had escaped destruction, granular corpuscles, granules isolated or aggregated in irregular masses, scattered about or grouped round the vascular walls.

At three millimetres beneath, beyond which the softening did not extend, microscopical examination revealed only a few granular corpuscles. The nerve tubes, cylinder axis, and myelin sheaths were healthy. The fourth ventricle was granular (papilliform fibroma) throughout. At a level with the calamus there were a few granulations, and also on the surface of the ependyma of the lateral ventricles.

The heart had undergone extensive fatty degeneration. The left ventricular wall was covered by a fatty layer, quite superficial, but in the right ventricle it extended more deeply. The mitral valve and the sigmoid valves were normal. The aorta was faintly yellow, but without elevated patches of atheroma. The lungs presented no other alterations than slight hypostatic congestion at the base posteriorly. The spleen was normal. The kidneys were somewhat yellowish in their cortical substance. The liver was slightly fatty, and exhibited a few yellowish patches.

Remarks.—The symptoms observed in this patient are those of ordinary general paralysis, and the fact of the epileptiform convulsions occurring on the left side receives a sufficient explanation in the predominance of the lesions (chronic interstitial diffuse meningo-encephalitis) on the right hemisphere. The fact of the greater frequency of unilateral affections of motility in general paralysis has long been known, and M. Baillarger had already noted in those general paralytics who kept their body inclined to one side that the lesions were more marked, and the weight of the hemisphere distinctly diminished on the side opposite. I have myself had frequent opportunities of observing the predominance of the lesion on the hemisphere opposite, not only the paresis, but also the unilateral convulsions. Yet in certain cases the affections of motility showing themselves more on one side are dependent on a circumscribed lesion, superadded to the diffuse interstitial encephalitis.

There is no doubt, however, that in this case the convulsions were due to the greater extent of the chronic inflammation of the right hemisphere.

But how can we explain the latency of the lesion in the left hemisphere? How can we account for the absence of all affection of the right side, notwithstanding the existence of a lesion so large and so deep of the upper two-thirds of the ascending parietal convolution? Why was the paralysis or paresis not more marked on the right? Is this, then, a fact in opposition to the theory of localisation? I do not think so. We have here to deal with a benign, indolent tumour, developing very slowly. The atrophy of the ascending parietal advanced by slow degrees, and rendered functional substitution possible.

The almost complete absence of adhesion of the membranes in the vicinity of the tumour deserves remark;—a clear proof of its independence and absence of influence on the chronic meningo-encephalitis.

COMPOUND COMMINUTED FRACTURE OF THE
SKULL, EXTENSIVE LACERATION, AND LOSS
OF BRAIN SUBSTANCE. OPERATION — RE-
COVERY — PARALYSIS.

BY A. BOLTON, M.B., B.A.,

District Medical Officer, Kustendjie, Turkey.

ABDUL AKIM, a Tartar, æt. 25, of strong and healthy constitution, arrived at my surgery on the 26th July, 1875, after being conveyed in a rough native bullock-waggon from his village, a distance of twenty miles. He was shaken a great deal during the journey. His father, who brought him, stated that the evening before he had had a fight with a gipsy, and during it the gipsy struck him a blow on the head with the back of a reaping-hook (the shoulder of the reaping-hook). His son immediately fell, and was then brought to his house for the night; nothing but an old dry rag having been applied to the wound until I saw him at 9.30 A.M., July 26th. He was then semi-comatose, breathing slow and puffing; extremities cold; p. 76, but of good volume; pupils natural and equal; he had lost very little blood. On examining the head, I found a small circular wound of the scalp, situated midway between the two posterior angles of the right parietal bone and about an inch in front of the sutura lambdoidalis, and a depressed fracture of the bone. From this wound brain matter was escaping, and, according to his father's account, had been coming away ever since the accident. His other friends, who came with him, confirmed the statement of the father with regard to the loss of brain matter, or, as they called it, '*piring ghib*' (cheese-like matter). Upon running my finger over the scalp corresponding to the seat of injury, I found no bony resistance whatever, and therefore concluded that the entire right parietal bone had been literally driven in. I accordingly at once determined to operate, and immediately sent for Mr. Riga, an active and intelligent

friend, who, though not a medical man, has frequently helped me in severe operations, and upon whose nerve I could depend. In half-an-hour my friend arrived, and having all ready I made the first incision, keeping on the edge of the firm bone, from near the anterior superior angle of the parietal bone to the root of the ear. Then a second incision was made from a little above the posterior inferior angle of the parietal bone to the same point, the angular junction of both incisions being situated at the top of the ear. I then dissected up the scalp to near the sagittal suture; under the scalp I found a considerable amount of sero-sanguineous fluid. I now introduced a probe: it passed down two inches, encountering no feeling of resistance. I now divided the periosteum upon a director and immediately there gushed out about an ounce of brain matter, in a pulpy state—still no bone visible. I next introduced my right index finger, and at a depth of about an inch I felt a sharp edge of bone; removing my finger I inserted blunt forceps, and grasping the bone tightly, I extracted it; it was standing perpendicular in the brain substance, was of irregular oblong shape, two inches in length and an inch and a quarter in its greatest diameter; it was slightly concave on its inner and convex on its outer surface. Again I introduced my right index finger in quest of more bone, but could find none immediately corresponding to the seat of depression. I accordingly bent up my finger, and running it along the under edge of the sound bone I felt another piece of the shape of an isosceles triangle, with irregular margins, and measuring one inch and a half from base to apex, and one inch across the base. This fragment was attached by dura mater to the sound bone, but doubled up underneath it, its outer or convex surface looking inwards. Seeing that I could not remove it without dragging injuriously upon the dura mater, I divided the latter all round the fracture, and removed it and the bone together; with this a considerable amount more brain matter came away, all broken down like the other. From the large size of the bony deficiency I judged there must be more broken pieces left. Again I examined, and found another portion nearly of the same shape and dimensions as the second piece removed. This piece was deep down in the substance of the brain: I extracted it with my finger and thumb, passed quite two inches into previously broken-up brain matter. Again I put my finger in and extracted in succession two smaller pieces, each of the size of a threepenny piece. At last, satisfied that I had found all the fragments, I removed a considerable quantity of debris, consisting of clotted blood and brain matter. Very little bleeding occurred; one small

artery spouted out when I divided the dura mater around the fracture, but I twisted and pinched it with forceps and immediately the bleeding stopped and never returned. I now drew down the flap of skin and united the edges by means of carbolised silk sutures. The angle at the ear was left free and open, so as to permit of the discharge of any pus, &c. Along the line of incisions I painted solution of acid carbolic (1 to 3); then applied a double fold of lint saturated in solution of carbolic acid (1 to 5), over this a larger fold of lint saturated in (1 to 10) carbolic solution; applied two turns of thin linen bandage round the head so as to retain the dressings. The patient was put to bed, and orders were given that the head was to be kept in such a position that the angle of the wound (incision) should always be dependent. The pads to be kept constantly moistened with solution of carbolic acid (1 to 10).

7 P.M. 26th.—Patient still semi-comatose. P. 88, and rather weak; pupils natural; feet cold. Not having passed urine since the accident, I drew it off to the amount of xxvi. , natural colour; ordered lotion as before, milk diet.

I shall now merely mention the particular symptoms which presented themselves until the discharge of my patient.

July 29th.—Inflammatory head symptoms began to appear. Ordered constant application of bladder filled with pounded ice to the head. R. Hydrarg. cum creta gr. iv. Tertia quaque hora sumendus. Room to be kept dark. Urine drawn off, 14 oz., loaded. Hot-water tin to feet.

30th.—Patient improved. Wound looking healthy, apparently closed except at angle from which there is a sero-sanguineous discharge. Pupils natural, conjunctiva slightly ecchymosed. Swallows his milk given by means of a spoon.

31st.—Much improved. P. quiet. Bowels acted involuntarily. Urine passed. Head cool. Cont. om. remedia, sed sumat Hydr. cum creta gr. iv. bis in die.

August 2nd.—Patient conscious, but no power of speech. Hears when spoken to. Both lower limbs, from hips downwards, paralysed. Left arm paralysed. Passes urine and fæces under him. Gums tender. To omit Hydr. cum creta. Continue ice-bag, and lotion to pads. Apply flannel bandages to both limbs from toes up to groin.

8th.—No change from former report, except that he seems more conscious. Paralysis as before. Continue treatment. To have chicken broth.

14th.—Much improved. Wound closed except at angle, from which there come slight discharges of healthy pus. Cerebral pulsation distinct. Bowels and bladder emptied voluntarily. Can move his toes, but not the limbs or arm.

Can use his right arm and hand. Laughs when spoken to, only moving the lips and tongue, uttering sounds similar to a child.

22nd.—Wound quite closed. Moves both legs. Left arm still quite paralysed. Power of speech lost. Otherwise quite well. Sits up in bed; eats mutton chops, chicken alternate days.

27th.—Walks a little with support. Only paralysis of left arm, loss of speech, and weakness of legs now remain. To remain in open air a good deal daily.

29th.—I found that by repeating the same word to him frequently he could imitate it. He accordingly learned his first word, "*Evet*" (yes), in this way. Other words I taught him similarly, and instructed his father to follow out the same plan.

This succeeded so well that on September 12th he could speak moderately well, but with a great deal of thickness.

On the 26th. of September he returned home, his condition being as follows: Healthy and robust, walks well, speaks moderately well, but is frequently at a loss for a word which had been familiar before the accident. Paralysis of left arm complete as before. I had four silver *mejedies* melted down, and made him a silver plate to wear over the seat of injury.

In the beginning of October I sent for this patient so that I might see his state. I found him well and healthy, full of smiles and gratitude, but with permanent paralysis of left arm.

CEREBRAL HÆMORRHAGE IN A CASE OF PYÆMIA.

BY HERBERT W. PAGE, M.A., M.C. CANTAB.

Assistant-Surgeon to St. Mary's Hospital.

M. T., a jockey, aged eighteen, who had always been strong and healthy, well-nourished, and accustomed to an active life, was admitted in the Cumberland Infirmary on July 1, 1872, complaining of great pain about the right knee. An indefinite history of "rheumatism some years ago" led the House Surgeon to attribute this pain to the same disease. The leg was placed on a splint, and warm fomentations were applied to the knee. On the following day there was some redness and tenderness about the head of the tibia; and on July 3, these, with other indicative symptoms, had so much increased, that it became necessary to make a free incision down to the bone. Pus was evacuated from beneath the periosteum, and a considerable area of bare bone was discovered. Light was further thrown on this acute periostitis and necrosis by a history, then only revealed, of his having been kicked by a horse some days before he came under treatment. The release of the subperiosteal pus gave much relief, and on July 4th, 5th, and 6th he was doing well. On the 7th it was noted that pulse, respiration and temperature were all high, and that his manner was excited; but there was no clear evidence of rigor. Early on the morning of the 8th the House Surgeon was called to him, and found him profoundly comatose, with complete and universal sensory and motor paralysis. The pupils were fixed and unequal, the right being larger than the left. His pulse was 144, his temperature was 103° Fahr., and the respirations were 54. He remained in the same state during the day, and died in the evening at half-past six.

The autopsy was made sixteen hours after death. The liver, the pericardium, the heart and its valves, the pleuræ and the lungs, were all perfectly healthy. The kidneys, the left more so than the right, contained numerous typical pyæmic deposits in different stages:—hæmorrhagic, sanguineo-purulent, minute

abscesses. Three pyramidal hæmorrhagic infarcts, not containing pus, were found in the spleen. On removing the dura mater a circular patch of effused blood, the size of a florin, was seen shining under the pia mater, just anterior to the centre of the superior surface of the right hemisphere. On slicing into the hemisphere, this patch was found to be the upper margin of a large clot of blood. The clot occupied a cavity with broken-down walls in the anterior and middle lobes. Towards the lateral aspect of the brain, and at the superior surface where it was first seen, this clot extended into the grey matter, but elsewhere it was confined to the white substance of the hemisphere, and it did not involve the corpus striatum, or materially encroach upon the corpus callosum. The walls of the cavity were generally ragged and uneven, as is usually seen when brain-matter has been recently torn by large hæmorrhage; but at the lowest part, where the blood-clot came well-nigh to the base of the brain, the wall was very soft, of a greenish colour, and distinctly purulent. Here was every appearance of there having been a small abscess, though, from the destruction of cerebral matter by the extensive hæmorrhage, no definable boundaries of an abscess were discoverable. There was no blood in the ventricles, nor other noticeable change beyond some slight distension of the veins on the surface of the brain and of the choroid plexus. The arteries at the base were all healthy, and no aneurism, dilatation or rupture of vessel could be found after very careful search. The clot was quite recent, and weighed two ounces and a half.

Cerebral hæmorrhage, by no means common in early life, cannot be spoken of as otherwise than most rare as a fatal lesion in pyæmia. Neither in the standard works on pathology, nor in the records of the Pathological Society of London, is there mention of any case at all like the present. How can this hæmorrhage be explained? It was too large to admit of the supposition that it could have been a pyæmic infarct in an early or sanguineous stage, the result of arterial occlusion, assuming that pyæmic infarct in the brain owes its origin to the arrest of embolon, or to the formation of thrombus.

As is well known, cerebral hæmorrhage in the young is more often due to the rupture of aneurism than to any other cause; but here no such lesion was to be found. Apart from the perfect healthiness of the heart and its valves, the history of rheumatism was too indefinite and too remote to admit of the probability of an aneurism having been at some time formed at the seat of an arrested embolon, which had become detached from some cardiac vegetation. Several cases are now on record which leave little doubt of the genesis of

aneurism at the spot where an embolon is stayed. Such—to name only recent instances—are published by Mr. Bryant and Dr. Goodhart in the 28th Volume of the ‘Transactions of the Pathological Society;’ and it is open to remark that, if embolon be indeed the precursor of pyæmic deposit, no matter in what organ or viscus, here too an embolon may have given rise to an aneurism, whose early rupture was the cause of this grave hæmorrhage. As Dr. Goodhart has shown (*loc. cit.*) the kind of embolon which has this action is not the embolon which comes from simple endocarditis, but rather that from “an ulcerating form of the disease, a very severe form generally producing fever and septic conditions;” an embolon, in fact, which, when detached, will “poison the part in which it is lodged, and lead to acute softening of the arterial wall by inoculating it with its own inflammatory nature.” This, to some extent, is the disposition, as we may so regard it, of a pyæmic embolon; but there are formidable objections to the acceptance of embolism as a source of pyæmic infarct in the brain. Rapid destruction of arterial walls, moreover, has not been recognised as an ordinary, or even as an exceptional, lesion in pyæmia, though the opportunities for it must have been abundant.

The hæmorrhage may be better accounted for, I am inclined to think, by the changed surroundings of the vessel which was ruptured. There was, it seems almost impossible to doubt, a small pyæmic abscess near the base of the brain. Accidentally impinging on one of the delicate vessels near the base, and in the substance of the hemisphere, this area of acute softening and suppuration robbed the vessel of the support which it naturally had when enveloped by normal and healthy brain. Aided, it may be, by the character of the pus around it, the walls of the vessel yielded at this point, and burst before many hours had gone by. That arteries may dilate or bleed under conditions of lost support is not unknown. Aneurismal protrusions into phthisical cavities of the lung may have this origin. So too the vessels in the wall of an hydrocele may yield and rupture after tapping of the cyst, and thereby fill its cavity with blood. In the 29th Vol., just issued, of the ‘Transactions of the Pathological Society,’ is a remarkable case of aneurism of the hepatic artery in the cavity of an abscess of the liver, and the growth of which is attributed by Dr. Irvine to the vessel having lost its normal tissue support. To a like cause Dr. Douglas Powell, in the same volume, is disposed to trace the formation of an aneurism of the coronary artery in an ulcer of the lower curvature of the stomach. In their remarks on “local cerebritis” (‘Pathological Anatomy,’ p. 231), Drs. Wilks and Moxon say of the broken-down cavity

of softened brain tissue, that "it may become the seat of apoplexy." Many writers indeed have at different times spoken of precedent softening as a condition likely to determine hæmorrhage into the brain. And although this view meets with the weighty opposition of Charcot and Bouchard (see Bouchard on 'Cerebral Hæmorrhage,' translated by MacLagan), there exists no inherent reason why that which is acknowledged as a cause of hæmorrhage in other viscera may not occasionally be the cause of hæmorrhage in the brain. The youth of the patient, and the absence of all sign of disease, lend further support to this opinion.

The case, at all events, is worthy of being placed on record as an example of cerebral apoplexy in early life, occurring under the unusual aspect of a fatal lesion in pyæmia.

CASE OF CEREBRAL TUMOUR.

BY JOSEPH W. HUNT, M.D., LOND.,

Physician to the Wolverhampton and Staffordshire General Hospital.

GEORGE P. æt. 37, married, locksmith, admitted as an in-patient, Oct. 9th. Owing to patient's condition when admitted it was impossible to obtain any satisfactory previous history. At his death the following points were elicited from his brother-in-law. For three or four months before admission he had complained of very severe pain in the left side of the head, and a fortnight before admission he staggered in his gait, so much so that he was thought to be drunk. For the last week or two his speech had been affected, and at times "mumbling." Latterly he had been unable to guide his food to his mouth, and required to be fed by his wife.

When at work, if he dropped a tool he would pick it up, but continue to search for it till he was told it was in his hand, when he would say, "What a soft I am!" After working for some time, if he wanted to put down a tool he would complain that he could not open his hand to put the tool down. There was an obscure account of his having had what was called a "stroke," but it did not prevent his continuing work. There was a history of phthisis in the members of his mother's family, and his paternal grandmother died of cancer of the breast.

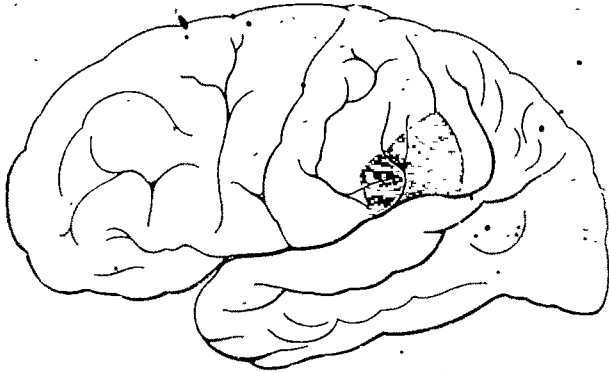
On admission patient was seen to be a strongly-made and well-nourished man. His expression was sleepy and heavy. No general or local œdema. Temperature normal. There was a copper-coloured papular eruption about the forehead and roots of the hair and the upper part of trunk. Edges of tibiae rather uneven. No markedly enlarged glands. Complained of no pain anywhere, but said his head felt "muddled." Memory much impaired, so much so that he could not remember the name of the street he lived in. He was quite incapable of even slight mental effort, the power of concentration and consecutive thought being apparently lost. He lay quite quiet

in bed, taking no notice of what went on in the ward, but would answer when spoken to, though in an abrupt manner, and in as few words as possible. Speech thick and his words very undefined, but he did not use wrong words. Sight good with each eye. No diplopia or hemiopia. An ophthalmic examination was made, but the discs were not seen, owing to patient being unable to fix his eye for any length of time. The retinal vessels appeared rather full. Hearing good. Muscles on right side of face rather weaker than on left, the angle of the mouth was down and the folds not so well marked. He could not show his upper teeth so well on that side. The tongue was protruded very slightly to the right. He complained of difficulty of getting down solid food, but could swallow fluids well. Grasp with each hand fair. No loss of power, sensation or reflex action in lower limbs. Tendo reflex present. Gait was very uncertain and staggering. He could not stand with his feet together, put his heels down first and had very much the walk of an ataxic patient. No cranial paralysis beyond what has been mentioned above. Pulse 48, very small and compressible. Urine free from albumen, sp. gr. 1012, acid. Abdominal and thoracic viscera normal.

The following day patient vomited twice, and at night got out of bed, giving the nurse some difficulty before she could get him back. He died rather suddenly, on the fifth day after admission, from œdema of the lungs, having occasionally passed his urine and motions involuntarily for the last day or two.

Post-mortem eighteen hours after death. Body muscular and well-developed. Rigor mortis well marked. Skull opened in usual way. On removing the dura mater the convolutions were much flattened and the sulci nearly obliterated. The surface of the encephalon presented a dry and glistening appearance. The superficial vessels were well filled, especially at the posterior portion, but even over the anterior part of the brain there was considerable capillary injection. On the left side in the region of the supramarginal and angular convolutions the brain rather bulged when the calvarium was removed and the dura mater reflected, and had a softened, almost fluctuating feeling. There was considerable effusion at the base of the brain, and probably into the ventricles. On removing the brain the softened part before referred to gave way and brought into view a tumour about the shape and size of a large walnut. The tumour was encapsuled and in connection with the meninges by a long pedicle which seems to be formed by a slender process growing from the meninges in the neighbourhood of the Sylvian fissure. There was no thickening of the meninges. The grey matter on the sur-

face of the tumour was not invaded, but was very much softened, and paler than normal. There was a considerable area of advanced softening round the tumour, having much the appearance of an abscess, and extending forwards to the fissure of Rolando, backwards to the occipital lobe, upwards to the middle line, and downwards to the Sylvian fissure. Besides this, the whole of the left side of the brain was rather softer than normal. The right side of the brain, on the other hand, appeared to be of rather increased consistence. The



tumour exercised distinct pressure on the island of Reil, and the ganglia in the lateral ventricle were pushed towards the middle line and encroached on the capacity of the ventricle. The extra ventricular portion of the corpus striatum was slightly softened. In the floor of the aqueduct of Sylvius there were some small superficial hæmorrhages, and also a few in the upper part of the floor of the fourth ventricle. The floor of the fourth ventricle had lost its smooth glistening appearance, and was rather softened. The normal lines and prominences were not distinguishable. The vessels in the substance of the pons were full and numerous, giving the appearance at places of hæmorrhage. *Puncta vasculosa* well marked throughout. Coats of vessels normal.

Nothing bearing on the case was found in the other organs beyond marked pulmonary œdema (the cause of death), and some mitral stenosis.

For a great part of these notes and post-mortem I am indebted to Dr. Russell, House Physician and Pathologist to the hospital.

A microscopical examination of the tumour showed it to be a round and spindled-cell sarcoma.

Abstracts of British and Foreign Journals.

Professor Broca on Cerebral Nomenclature.—Professor Broca (*Revue d'Anthropologie*, tome 1^{re}; 2^{ème} série, pp. 193-236, 1878, and *Bulletins de la Société d'Anthropologie*, tome xii^{ème}, 2^{ème} série, p. 614, 1877) has recently directed attention to the fact that the terms used in the descriptions of the convolutions of the brain date from a period when these latter were regarded as mere folds without definite arrangement (*désordonnés*), and when there was no distinct notion of the relative value of the numerous divisions and subdivisions of the surface of the hemispheres. At this period the choice of terms was of no importance; but now that each hemisphere is divided into a definite number of lobes, and these into convolutions having an arrangement more or less constant in animals of the same species, the adoption of a definite terminology is of obvious necessity.

In order to arrive at this end, there is no necessity to create new words, for there are already in the cerebral vocabulary more terms than there are things to designate. Those terms, moreover, which by general usage have come to receive a pretty precise acceptation in anatomy had better be retained, even if they are not perfectly appropriate. For instance, the lobes are not always lobular in form, nor are the convolutions always convoluted; but as the anatomical signification of these terms is generally understood, such nomenclature suffices. But there are other and more numerous terms of which the signification is not as yet fixed; such, therefore, need not be approached with the same reserve.

The *ensemble* of the convolutions of a hemisphere constitutes that which Bardach has termed the *manteau*. This covers the cerebral mass, or body of the hemisphere, in all parts except a region on the internal aspect, limited above by the *corpus callosum*, and below by the lateral branch of the fissure of Bichat. The primary divisions of the mantle are called *lobes*. Their number and terminology are no longer a subject of doubt and controversy. The secondary divisions are termed *convolutions*. Each lobe comprises a certain number of these, which are definite organs, determined anatomically by their

origin, termination, and relations. Each convolution has received a particular name, which varies considerably according to the different systems of nomenclature. The numerical terminology is the best, and is the most usual; and, accordingly, the most preferable mode is to place, in every given lobe, the number 1 upon the convolution which is nearest the superior or *sagittal* border of the hemisphere, and so on, so that the convolutions nearest the base have the highest number. Such terminology is applicable to all the longitudinal convolutions, *i.e.* to all with the exception of the ascending frontal and parietal, which run transversely along either margin of the fissure of Rolando.

The word *pli*, employed at first by Gratiolet as a synonym of the word *circonvolution*, must now be used in a more restricted sense to designate certain parts of a convolution, and a distinction must be accordingly made between *plis de communication* and *plis de complication*. The former are superficial or deep extensions, which pass from one convolution to another; but if the two convolutions which communicate belong to different lobes, the *pli* is termed a *pli de passage*, but if to the same lobe, a *pli d'anastomose*. The *plis de complication* may further be subdivided into *plis d'inflexion* and *plis de subdivision*. The first result from the sinuosities which the convolutions describe when they are longer than the distance comprised between their two extremities, while the latter are those produced on the surface of a convolution between its ridges. The limits of the lobes, of the convolutions, and of the *plis* are formed by lines of depression of variable length and breadth, which were termed for a long period *anfractuosités*. This term, though but little employed nowadays, should be revived, as being best applicable to all the depressions of the central surface. As there are three orders of divisions, or sub-divisions, of a hemisphere, so are there three orders of anfractuosités: 1, Those which separate the lobes, the *scissures*; 2, Those which bound the convolutions, the *sillons*; and 3, those which sub divide or "complicate" the convolutions, namely, the *incisures*. These latter are, further, of two varieties, the *continuous* and the *isolated*; the first corresponding to the *plis d'inflexion*, while the second answer to the *plis de subdivision*. These three terms, the first especially, have frequently been used as synonyms of each other, and even in the general sense as expressed by the term *anfractuosity*; being, moreover, employed somewhat loosely, and rather with reference to the relative value of the words than with regard to the relative importance of the things which these designate; for that which determines the

importance of an anfractuosity is neither its length nor breadth, but the kind of division which it establishes.

J. C. GALTON.

Krueg on the Cerebral Sulci in the Ungulata. ("Über die Furchung der Grosshirnrinde der Ungulaten." *Siebold and Kolliker's Zeitsch. für Wissensch. Zoologie*, **xxi.** Bd. § 297; Taf. **xx.-xxii.**) —The sulci of the cerebrum in the Ungulata have been lately investigated by Dr. Julius Krueg from a developmental [or evolutionary] point of view, in which relation they have up to this time been but little studied.

Of this work the following are the most important conclusions:—

1. Temporary sulci are never present as precursors of permanent furrows; and there is, moreover, no evidence that any sulcus, when once traced out, is ever eventually interrupted at any point of its course.

2. The most important sulci which are most constantly present in the rest of the mammalia are the first to make their appearance in the foetal brain; in such wise appear those "primary sulci" which are present in the Ungulata.

3. The brain in adult specimens of the class Ungula shows an unusually large number of individual variations.

4. A much more striking influence than the place of the individual animal in the zoological scale is exercised by their size upon the form of the cerebral hemispheres. And this influence makes itself felt in the following way:—Together with the size of the brain, consequently too with that of the animal, is the sum total of the accessory sulci increased; and, further, the general form of the cerebrum undergoes alteration, in accordance particularly with the build of the skull; finally, it appears that the larger the brain the more will homologous cortical portions of the convex surface of the cerebrum be pushed over the longitudinal margin of the hemisphere upon the median surface, while in the case of the brains of smaller animals, on the other hand, cortical districts are to be found on the convex surface which in larger animals belong to the median aspect of the hemisphere. Such changes are termed by the author "pronation" and "supination."

H. OBERSTEINER.

Recent Work in Visceral Neurology. THE VAGUS.—A valuable observation upon the anatomy and physiology of the vagus in the neck of the rabbit has been made by Steiner (*Archiv f. Anat.*

u. *Physiol.* herausg. Von His, Du Bois-Reymond, &c., 1878, III. and IV., p. 218). In the course of an attempt to unravel this highly complex nerve in the upper cervical region, Steiner performed the following experiment upon a rabbit. He carefully exposed the vagus in the neck, and split it longitudinally in the middle line from a spot close below the ganglion until the nerve entered the thorax. Naming the two bundles of nerve thus obtained the *inner* and the *outer* bundle respectively, Steiner proceeded to test the functions of each by faradization. He made the highly important discovery that the *inner* bundle of the vagus consists of *motor* fibres, while the *outer* bundle contains only *afferent* fibres to the medulla. Starting from this result, Steiner carried out the investigation into the effect of section of either set of fibres upon the nutrition of the lungs which is described below under the title of "*Trophic nerves*."

Wasylewski has tried upon many persons, both sound and suffering from disease, the well-known experiment of Czermak of irritating the vagus in the neck by pressure upon the carotid sheath. At the same time the sphygmograph was applied to the radial artery (*Prager Vierteljahr*, No. 138, p. 69; and *Centbl. f. med. Wiss.* 1878, No. 39, p. 718). In about 60 per cent. of the cases, and more frequently in sick than in sound persons, the phenomena of irritation of the vagus were induced; namely, slowing or arrest of the heart, and acceleration of the respiratory movements. Only in two cases were dangerous complications observed.

THE HEART.—The effect of excitation of the organs of special sense upon the cardio-vascular system has been the subject of experimental investigation by MM. Couty and Charpentier. (*Arch. de Physiologie*, &c., 1877, p. 525.) Dogs were curarized, and the senses of sight, hearing, smell, and taste were irritated in a variety of ways. The result was that the heart was found to be disturbed in all cases; but that no connection could be discovered between the character of the irritation, on the one hand, and the reaction of the circulatory organs on the other. The heart was sometimes accelerated and sometimes slowed, and the pressure was sometimes raised and sometimes depressed, in the same animal. This great variableness of the disturbances distinguished them markedly from the disturbances due to *peripheral* impressions. The conclusions at which the authors arrived were, that the cardiac phenomena were brought about through the vagi only; that the brain is indispensable for the production of the reflex phenomena both in the heart and in the vessels; and that the medulla and

cord are not primarily concerned in the reflexion of such special sensory impressions to the vessels, as in the case of peripheral impressions. The seat of primary reflexion is the cerebral centre associated with the organ of sense; and it is in this way that the extraordinary variety in the results of irritation can be accounted for. The cerebral centre acts secondarily through the medulla. It is necessary, however, before an impression can be transmitted to the circulation that it be "perceived" by the cerebral centre.

"TROPHIC NERVES."—The effect of complete section of the vagi nerves in the neck, in producing acute inflammation of the lungs and early death, has been familiar since the classical researches of Traube upon the subject. Traube referred the pneumonia that so frequently follows the operation to paralysis of the digestive canal, from the throat to the stomach, and the consequent accumulation in the œsophagus and overflow or aspiration into the respiratory passages of the secretions of the mouth and particles of food. However, this explanation of the facts was not accepted by all pathologists; and the phenomena are still cited by the supporters of the theory of "trophic nerves" as evidence in its favour. Steiner has reinvestigated this subject experimentally (His, Braune, and Du Bois-Reymond's *Archiv f. Anat. und Physiol.*, 1878, III. and IV. p. 218) in consequence of a valuable discovery which he had previously made upon the anatomy and physiology of the vagus in the neck, and which we have described above (see "*Vagus*"). Being able to divide the vagus at pleasure into a motor and a sensory bundle, Steiner was prepared to test the effect of section of either bundle separately, or of the two bundles in succession, upon the vital processes in the lungs. He performed many experiments upon rabbits, all of which confirmed Traube's theory of the mechanical or "non-trophic" cause of the resulting pneumonia. He next found that section of the motor bundle of the vagus on both sides was followed by an extensive pneumonia within a few days. The same cause was doubtless at work here as in complete section of the vagi—namely, paralysis of the œsophagus and larynx. The next question was, whether this paralysis was the sole cause of the pneumonia. Ligation of the œsophagus at its middle point along with section of the recurrent laryngeal nerves produced exactly the same result. But inasmuch as complete section of the vagi was followed by as rapid and extensive pulmonary changes as the comparatively coarse operation of ligation of the œsophagus, Steiner suspected that another factor than the paralysis must be at work in section of the vagi, which influenced the substance of the

before death, elevating the patella. After death one of these joints contained about two ounces of a dark purulent liquid; the synovial membrane was thickened, infiltrated, and indurated; and its fringes were opaque and purulent in aspect. The cartilages were covered by flakes of pus, while those of the inner aspects of the ends of the bones had entirely disappeared, leaving the denuded tissue beneath porous and friable. The other knee-joint contained only a quantity of lemon coloured liquid. The marrow of the bone in the vicinity of the joint most affected had undergone fatty change; and the bony tissue itself presented all the signs of osteitis.

Another case of disease of the cord which has a bearing upon the trophic theory, as regards the voluntary muscles, is recorded by Aufrecht (*Deutsch. Arch. f. klin. Méd.* xxii. 1, p. 33). The clinical characters of the case, which occurred in a woman of twenty-three, were those of subacute spinal paralysis ("Paralyse générale spinale subaiguë" of Duchenne). The following is the summary of the post-mortem appearances: Atrophy of the ganglion-cells of the anterior horns of the entire cord with the exception of a very small portion—namely, their most anterior part. Atrophy of the ganglion-cells of the anterior part of the posterior horns, especially in the lumbar region. Patchy atrophy of the ganglion-cells of Clarke's columns. Atrophy of the medullary sheaths in the anterior columns. Thickening of the walls of the vessels of the cord. Advanced swelling of the epithelium of the connective-tissue-capsules of the spinal ganglia, and swelling of the nuclei of the capillaries and of the adventitia of the vessels in the same. Degeneration and regeneration of the peripheral nerves supplying the diseased muscles, with swelling of the nuclei of the capillaries and of the adventitia of the smaller vessels in the interstitial tissue of the same. Degeneration and regeneration of all the affected muscles, with the most advanced swelling of the nuclei on the capillaries of those muscles which were in the most advanced stage of disease. Contrary to expectation, Aufrecht found that *the spinal roots were perfectly normal*, on the most careful investigation. He has therefore to deny a direct anatomical connection (*i.e.* through nervous elements) between the affection of the ganglion-cells of the cord and that of the muscles in subacute spinal paralysis.

Dr. Weir Mitchell describes a new form of vaso-motor neurosis of the extremities which he has not seen fully noticed elsewhere (*American Journal of Medical Science*, July 1878, p. 17). The subject of this "foot-disorder," nearly always a man, after some constitu-

tional disease, such as a low fever, or after prolonged physical exertion on foot, begins to suffer from pain in the foot or feet. This usually commences locally on the sole, and extends so as to reach the dorsum or even the leg. It is increased by exertion or heat, and relieved by rest in the horizontal position, and by cold; its character being generally *burning*. Accompanying the pain is flushing of the part on exertion, and in chronic cases this hyperæmia may remain as a dull, dusky mottled redness. Even *distering* may ensue if walking be persisted in. The flushing is thus described:—"The foot gets redder and redder, the veins stand out in a few moments as if a ligature had been tied around the limb, and the arteries throb violently for a time, until at length the extremity becomes of a dark purplish tint. In a few moments the flushing becomes passive, the arteries cease to throb, the heat lessens, and there is evidence of lessened oxidation. 'In the worst cases, when the patient is at rest, the limbs are cold and even pale.'" In two cases seen by Dr. Mitchell, the disorder appeared to have been associated in the later stages with distinctive evidence of spinal disease, such as atrophy, the painful belt, partial loss of power, and other phenomena. In another case the upper extremity was affected after a time. Treatment has hitherto proved unsuccessful. Dr. Mitchell believes that these cases represent an unrecognized type of spinal or cerebro-spinal disorder, and that they may yet be found to be associated with distinct lesions of definite nervous regions. The vaso-motor disturbance must be looked upon either as caused by the implication of vaso-motor centres or as due to a reflex affection caused by the pain or by the disorder of the central organ, disease of which gives rise to pain—the pain in all cases seeming to precede the vaso-motor phenomena.

Mr. Gaskell's researches upon the vaso-motor nerves of ordinary muscles to which reference was made in this *Report* for July have been greatly extended since that date, and an account of them will be found in the *Journal of Physiology*, Vol. I. Nos. 4 and 5, p. 262. Gaskell had already shown that section of the nerve belonging to any particular muscle or group of muscles causes a great temporary, not permanent, increase in the amount of blood that flows from the muscle vein; and, further, that stimulation of the peripheral end of the cut nerve causes, not only tetanus of the muscle, but also a very marked increase of the rate of flow through the muscle—which increase takes place either after the termination of the tetanus, or (if the stimulation last long enough) even during the tetanus itself. He afterwards concluded, from experiments on

frogs, that this increased flow of blood through the muscle was due to the action of dilator fibres in the nerve, the arteries of the muscle being made to dilate by the direct stimulation of their nerves. Section of the nerve produces dilatation, first, because it removes the tonic action of the central nervous mechanisms; and secondly, because the mechanical act of section constitutes a strong stimulation of those dilator fibres. Gaskell left it to be ascertained in his subsequent researches whether similar vascular dilatation occurred in voluntary and in reflex muscular action. He now finds that the increase of flow caused by stimulation of the crura nerves in the dog is due, as in the muscles of the frog, to the direct excitation of dilator fibres. This dilatation attains its maximum very quickly, and lasts only a few minutes after the section. A rise of temperature of the muscle follows the section, attains its maximum at a time when the dilatation of the vessels has already ceased, and continues for a considerable length of time after the section. The thermometer does not, therefore, afford a good indication of the fulness of the muscle-vessels at any given time; and the conclusions at which Heidenhain has arrived respecting the state of the vessels after section of the nerves, from observations of the temperature, and which were directly opposed to Gaskell's conclusions, must therefore be received with caution. Gaskell agrees with Heidenhain, that besides these dilator nerves, constrictor fibres are also present in the muscle nerve, but that they are insignificant in comparison with the dilators. The difference between the vessels of the skin and the vessels of the muscles is that in the latter the dilator fibres predominate, while in the former the constrictors predominate. Next, with respect to the effect of stimulation of an afferent nerve upon the blood-flow through the muscle, Gaskell concludes that, "dilatation of the muscle-vessels takes place upon stimulation of an afferent nerve when that stimulation causes either an actual or a potential contraction of the muscle (meaning by a potential contraction that the contraction would have occurred but for the hindrance interposed between the central nervous cells and the muscular fibres in consequence of the action of curare)." On the other hand, contraction rather than dilatation of the muscle-vessels is caused when an afferent nerve, such as the vagus, is stimulated which does not cause any contraction of muscles.

RESPIRATION.—*New Respiratory Centre.*—From experiments upon rabbits and cats, Drs. Martin and Becker (*Journal of Physiology*, Vol. I. Nos. 4 and 5, p. 370) have come to an important conclusion